Innovation and the Internationalization of Firms in the Service Industries:

Empirical Evidence from a New Survey

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Master's Thesis

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Spring 2010

Acknowledgements

I would like to thank all the people who have challenged and supported me during my years at the University of Oslo. It has been many years, and the thesis marks the end of a long academic journey and is the result of several accumulated ideas and experiences gained during my time as a student.

My supervisor Fulvio Castellacci has given me excellent guidance and feedback on my work. Also a great thanks to all the students and employees at the TIK-Centre, it is truly a unique experience to enroll as a Master's student in such an inspiring and multi-disciplinary environment. I highly appreciate the student scholarship from the Department of International Economics at the Norwegian Institute of International Affairs (NUPI). It has allowed me to spend more time on the data collection and the data preparation phases, as well as included me in a stimulating research environment. I would also like to thank Gbewopo Attila for teaching me the statistical software Stata in a gentle way.

I am grateful for all my close friends who have been supportive all the way, and especially during the last year. Magnus Halvorsen did an excellent job in proof reading the final draft. Thanks to my girlfriend Christine, who has patiently taken care of me during the final writings on my Master's thesis. My mother deserves the greatest appreciation, for always supporting my ambitions and dreams. She is the best inspiration any person can hope to have.

All the mistakes and errors in the thesis are mine, and mine alone.

Kim Rudi Dreyer,

Oslo, May 2010.

Abstract

Innovation and the Internationalization of Firms in the Service Industries: Empirical Evidence from a New Survey

There is a growing interest in the service sector in industrialized countries due to its increasing employment share, contribution to economic growth and internationalization patterns. While the service innovation literature has extensively investigated the relevance of innovation for explaining the growth of the service industries (Miles 2005), little is known about the patterns of internationalization in this branch of the economy, the strategies adopted by service firms and the set of possible explanatory factors.

In order to shed new light on these issues, data on Norwegian service firms were collected through a web-based survey. The survey contained 25 questions on firms' innovation and international activities in the period 2004-2006, and eventually collected a total of 814 completed surveys in a large number of service sectors (with an average response rate of 19%). The survey focused on three internationalization channels: international sales (e.g. export and foreign direct investment), international cooperation and R&D outsourcing, each corresponding to the three types of the well-known "globalization of technology" taxonomy (Archibugi and Michie 1995). In addition, data on different barriers to internationalization and innovation strategies were collected. The service industries were divided into four categories, based on the sectoral taxonomy developed by Miozzo and Soete (2001) and later refined by Castellacci (2008).

The empirical analysis of the newly collected survey data is carried out in three subsequent steps. First, it presents descriptive statistics of the main patterns. Secondly, it presents the results of an analysis of variance (ANOVA) in order to point out different innovation and internationalization patterns among the four sectoral groups. Thirdly, it presents the results of a regression analysis (logit model), in which the dependent variables are the various internationalization channels adopted by the firms, whereas the set of explanatory factors include their innovation activities, barriers to internationalization and a set of other firm-specific control variables. The results of the analysis highlight the importance of innovative activities, barriers to internationalization, and firm-level characteristics, and also point out that some of these factors differ substantially across the service sectors.

Keywords: innovation; internationalization; service industries; sectoral taxonomy; barriers to entry; globalization of technology; survey data.

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1 Introduction

There is a growing interest in the service sector in industrialized countries due to its increasing employment share, contribution to economic growth and internationalization patterns. While the service innovation literature has extensively investigated the relevance of innovation for explaining the growth of the service industries (Miles 2005), little is known about the patterns of internationalization in this branch of the economy, the strategies adopted by service firms and the set of possible explanatory factors. Internationalization of services is an increasing phenomenon, and has implications for economic growth, welfare and the composition of the economy.

Service innovation and internationalization of services are two interrelated topics of increased interest. According to the European Monitoring Center on Change (2005) the service sector now constitute the majority of employment and output in industrial countries. There has also been an unprecedented growth in export and foreign direct investments (FDI) in services. International trade in services accounted for about 30% and 60% of FDI in the OECD area is targeted towards services (Grünfeld and Moxnes 2003). Several reasons have been proposed to explain the rise and growth of the service industry. One is the income elasticity of the consumption of services, while another is the outsourcing argument (Castellacci, Karpaty, Laursen and Tingvall 2009). Other reasons may be political liberalization and trade agreements on services, such as EU's internal market, North America Free Trade Agreement (NAFTA) and the General Agreement on Trade and Services (GATS).

This thesis is motivated by the growth and internationalization of the service sector. Manufacturing has been the centre for research on innovation and internationalization for a long time. However, the increasing growth of the service industries justifies further investigation of these topics. Innovation and knowledge development have played a crucial role in Norway. New theoretical and empirical approaches help to further understand Norway's economic development from being one of the poorest countries in Europe, to become one of the richest countries in the world (Fagerberg, Mowery and Verspagen 2009). The thesis seeks to further investigate some of these issues, such as innovation and internationalization channels in the Norwegian service industries.

1.1 Research Questions

Most of the literature on innovation and international performance has focused on manufacturing, and neglected or marginalized the service sector. Statistics and research on international trade has also pointed out the growth and economic importance of services, while innovation and sectoral differences have been left alone and not been integrated. It is therefore a plausible idea to further investigate these phenomena by combining the different strands of literature and test some of these assumptions empirically in a Norwegian context. One of the main factors that have slowed the progress in this field has been the lack of reliable data and empirical evidence to complement the proposed theoretical contributions. Motivated by this gap in the literature on innovation and internationalization of services, the following research questions will be investigated empirically:

- **What characterizes innovation and internationalization in services?**
- **How do different barriers affect this link?**
- **How does this relationship differ among service industries?**

To properly investigate these research questions, a survey was made to collect data on Norwegian service firms, and investigate their innovative and international performance. The collected data material is labeled “Service Internationalization Survey” (SIS), and is found at the Norwegian Institute of International Affairs (NUPI), at the Department of International Economics.

1.2 Motivation and relevance

The literature on innovation and internationalization of services is less developed than the literature investigating manufacturing. The main motivation for exploring the research questions is the lack of substantial research on some of these topics.

This study contributes with new data and analysis of an emerging multidisciplinary field of academic research on service innovation and internationalization of services. Further development of theory and empirical models for understanding and measuring the service sector is of great significance, both for basic and applied research. The collected data may therefore be considered an important contribution itself and not only an instrument to answer the research questions of this thesis. The data collection will also be helpful in exploring the international aspects of the Norwegian service industry.

The literature on innovation in services points out the difficulties of identifying and correctly measuring innovations in services. Innovation studies have usually been occupied with manufacturing. This branch of research has developed recently, but has historically been hampered by old assumptions of services as being innovation laggards or non-innovative (Malerba 2005). There has also been a lack of suitable data sets to do proper analysis. Furthermore, innovation and economic performance seem to be closely linked. Exports, competitiveness and productivity all interrelate with innovation in services, and also motivates a further investigation of these factors. Services are by nature intangible, which makes them harder to transport, store and export. The use of information and communication technologies (ICTs) seem to have contributed to an increase in efficiency and tradeability of services (Evangelista 2000). ICTs is highly compatible with service firms, due to their fundamental characteristics of interactivity and information intensity (Sapprasert 2007).

There has been a distinction between three theoretical approaches to innovation in services: assimilation, demarcation and synthesis. These perspectives have helped to understand the nature of services. There is also a relationship between innovation and economic performance, even though this relationship has been less investigated, due to methodological and conceptual difficulties (Castellacci et al. 2009). Innovation is clearly positively affected by past economic performance and innovation activities have a positive impact on growth and productivity.

1.3 Structure of the thesis

This first chapter introduced the main topics of the thesis. It presented the research questions, as well as the motivation and relevance underlying the thesis, and an outline of the work that is to be presented.

Chapter two introduces the theoretical framework that is used. It covers the internationalization process of firms, mainly export and FDI, international cooperation and international research and development (R&D). It also reviews literature on innovation and internationalization in services, and introduces a taxonomy for globalization of innovations and a new taxonomy of sectoral patterns of innovation. The purpose of this chapter is to prepare the empirical analysis that follows.

Chapter three presents the chosen research methodology and the questionnaire that was used to capture the nature of service innovation and internationalization of services. The data collection process is described in more detail, and descriptive statistics of the main patterns are provided.

Chapter four continues with statistical analysis and presents the results of an analysis of variance (ANOVA) in order to point out different innovation and internationalization patterns among the four sectoral groups. It also presents the results of regression analysis (logit model), in which the dependent variables are the various internationalization channels adopted by the firms. The set of explanatory factors include their innovation activities, barriers to internationalization and a set of other firm-specific control variables. The results of the analysis highlight the importance of innovative activities, barriers to internationalization and firm-level characteristics. Some of these factors also differ substantially across the service sector.

Chapter five concludes and summarizes the main findings, and suggests some implications for policy making. The questionnaire that is used in the survey is attached in the Appendix.

2 The Internationalization Process of Firms

2.1.1 Export and Foreign Direct Investment (FDI)

Export is when a company is selling goods and services, produced in the home country, in a foreign market. An important part of international capital movement is foreign direct investment (FDI), which is defined as international capital flows where a firm in one country creates or expands a subsidiary in another (Krugman and Obstfeldt 2003:171). The distinctive feature of FDI is that it does not only involve the transfer of resources, but also the acquisition of control, since the subsidiary is part of the same organizational structure. The volume of FDI has been increasing rapidly over the last two decades. It is assumed that this increase is closely linked to the strategies of firms and technology acquisitions, diversification and exploitation (Carlsson 2006:61). Exporting also makes it possible for the firm to benefit from economies of scale and scope at the production facility in the home country (Besanko, Dranove, Shanley and Schaefer 2004). Wicken (2009) also notes that large-scale and centralized Norwegian enterprises seem to exploit economies of scale and scope in capital intensive industries where FDI has been prominent in Norway.

Usually, new trade models take for granted that technology and productivity is similar for firms within the same industry (Helpman 2006:592). Therefore, all firms within each industry should be able to export to all countries. This assumption contrasts sharply with empirical evidence. In each industry only a small fraction of firms are exporters, while the majority of firms produce only for the domestic market. Exporters are different from non-exporters. They are usually larger, more capital and skill intensive, and also seem to be more productive. The empirical evidence has therefore contributed to the flourishing of heterogeneity models within mainstream economics (Castellacci 2010b). Melits (2003) model became the cornerstone of a growing literature known for investigating the role of heterogeneity in international trade and FDI. The model combined old and new approaches to trade theory, and provided rich predictions that could be confronted with new data sets. This model has also been performing well in empirical analysis (Helpman 2006:593).

The literature on firm-level export performance is substantial, and is still progressing in a number of contexts (Laursen 2008). Different export behavior is demonstrated for different firms in the same context, located in the same country and within the

same industry. A number of firm-specific characteristics, such as size, productivity and previous export performance seem to be important. This difference is found within sectors, and across production units. The literature refers to massive differences in performance outcome, even when taking into account specific sectors. Overall, the literature does not seem to account for sectoral differences and these differences in firm performance are strongly correlated with the firm's decision to engage in international activities and transactions, such as export and FDI.

Bernard and Jensen (1999) made a study of US manufacturing plants. Good firms became exporters, and the firms that exported already had several of the beneficial characteristics. They found that productivity growth of exporters were not significantly different between exporters and non-exporters and exporter's learning effects from their exporting activities where not permanent. Future exporters in their study (2-3 years before exporting) were also documented to be larger firms, higher wages and higher labour productivity levels. However, plant survival and secured employment growth are more likely at successful exporters, but productivity drops compared to those that do not export.

The analysis of firm-level evidence revealed some new facts that were not observable at the aggregate level (Mayer and Ottaviano 2007). The international performance of European countries is driven by some few firms. Liberalization and increasing cross border trade triggers a selection process, where the most productive substitute the least productive ones within sectors. This is beneficial for productivity, GDP and wages. FDI makers perform better than exporters, and exporters perform better than non-exporters. Exporters are generally bigger, more profitable, more capital intensive, more productive and pay higher wages. By the same measures, FDI-makers perform better than exporters.

The strong correlation between export status and firm characteristics leads to the question of causality. Are productive firms becoming exporters, or are exporters becoming more productive, as a post-entry effect? There seems to be a certain consensus in the literature that productive firms become exporters, so-called "learning to export" (Bernard and Jensen 1999; Helpman 2006; Bernard et al. 2007).

It also appears to be a link between export performance and innovation. The most successful firms usually undertake both innovation (higher technology use) and export status, while the less successful firms usually undertake neither (Laursen 2008). Increased competition in foreign markets forces firms to be more efficient and

stimulates innovation (Greenaway and Kneller 2007:145). It is therefore natural to expect that introducing a new service innovation will be correlated with having export or FDI present. Beise-Zee and Rammer (2006) point to the local user-producer interaction in innovation and export performance of firms. They combine different strands of literature in order to shed light on the link between innovation and export in both manufacturing and services. The rate of innovation generated by a firm is positively correlated with its export performance. The idea is that innovative firms will also have a lead in the use of new technology, and thus outperform its competitors. The empirical results on this topic, however, seem to be mixed.

Firms' different innovation strategies is usually explained by differences across sectors or countries (Srholec and Verspagen 2011). Sectors and countries matter to a certain extent, but most of the variance is given by heterogeneity among firms within sectors and countries. Firms are becoming increasingly specialized along the value chain of an industry (Knell and Srholec 2006), and this implies an increased heterogeneity of firms as well. Each part of the value chain requires different resources and capabilities developed over time, and is reflected in economies of scale and scope.

Cassiman and Golovko (2007) investigate the relationship between innovation activity, productivity and export. Based on a panel of Spanish manufacturing firms for 1990-1998, they find that firm innovation status is highly important in understanding the positive export-productivity. The authors cite a number of influential empirical studies that documents the positive and significant effect of R&D and innovation on firm productivity and productivity growth. Innovation affects the propensity to export or conduct R&D abroad. They also refer to recent studies indicating that innovation is itself a very important driver of the export decision. Overall, these empirical findings indicate that innovation activities in the firm both affect the productivity improvement and export orientation. By using a gravity model of trade, and a "technological achievement index", Marquez-Ramos and Martinez-Zarzoso (2010) also find a positive and non-linear effect of technological innovation on export performance.

The OECD Policy Brief (2007) on competition and barriers to entry states that before a firm can compete in a market, it has to be able to enter it. Many markets have at least some impediments that make it more difficult for a firm to enter a market. A debate of how to define and limit barriers to entry have been going on for several years. There are additional costs associated with selling goods in foreign markets

(Bernard and Jensen 1999:7), such as transport costs, expenses related to setting up distribution channels and production costs to modify domestic models for foreign tastes. Although these costs have declined over time, especially due to the introduction of ICTs, these costs still provide entry barriers for firms wanting to enter foreign markets. There are large sunk costs when exporting to and from developed countries, and these sunk costs can be seen as barriers to internationalization, as will be investigated in the empirical part of this thesis.

Geographical distance constitute an obvious barrier, as illustrated by Mayer and Ottaviano (2007). If country A is on average 10% further away from other countries than B, then it trades 9% less than B with other countries. Sharing a language increases the number of exporters and does not affect the average amount exported. GATT and WTO membership and colonial links increase the number of exporters and reduce the average amount exported. Firms average exports per product matters less. The changes in the number of exporting firms and in the number of exported products accounts entirely for the negative impact of higher trade barriers and the positive impact of larger countries size on bilateral exports. Lack of institutional standardization may also hamper the efficiency of internationalization by MNEs (Miozzo and Soete in Miozzo and Miles 2002:18), since the degree of technological standardization in relation to physical proximity has been achieved already. The importance of networks have grown in importance for successful innovations (Powell and Grodal 2005). Various forms of partnerships between multinational enterprises (MNEs) are now essential in corporate strategy. If the costs of building a resourceful network are too high, it may clearly reduce the incentives to internationalize.

Sunk costs can be seen as barriers to entry (Greenaway and Kneller 2007:151). This includes transportation costs, costs of setting up local sites, integrating into the local network and tap into the local labor market. Sunk costs of exporting are usually thought to be fixed costs of research into product compliance, while FDI imposes a duplication of costs in establishing domestic production facilities. On the other hand, FDI eliminates variable transport costs, but involves higher fixed costs. It seems that only the most productive firms become multinational. There are clearly barriers in setting up distribution networks, advertising agencies and so on.

The barriers investigated in the survey may also be interpreted as proxies for components of a national innovation system, which the literature is arguing is still

important in many aspects, and is therefore expected to affect the degree of internationalization of the firms in the survey. Close geographic proximity and connection between the different actors are required for successful spill over to take place. This could lead to the formation of clusters, where universities play a central role, and MNEs tend to centralise their location close to these actors.

2.1.2 International Cooperation and International R&D

Multinational enterprises and their growing involvement in international collaborative venture is of increasing importance (Saliola and Zanfei 2009:370). Empirical studies on international joint ventures have been around since the mid 1980s. International cooperation refers to active participation in one or more activities with other enterprises or non-commercial institutions that are located abroad. Usually this sort of cooperation includes technological collaboration to develop know-how or innovations, where the partners preserve their identity and ownership. International R&D joint ventures have received much more attention the last decades (Archibugi and Michie 1995:127). Firms operating in competitive markets have usually been reluctant to share know-how related to technology. However, an empirical investigation by Baumol (in Archibugi and Michie 1995) reveal that firms are more willing than expected to undertake these types of cooperation. One reason for the increase in international joint ventures seem to be that firms in this new technological paradigm are more knowledge intensive, and therefore require more state-of-the art knowledge from external sources of the firm.

The growth of collaborative activities are greatly influenced by the process of globalization, which has affected the need of firms to collaborate. They now seek the opportunity to cooperate, rather than just aiming for situations to have control. This is even more profound in the capital and knowledge intensive sectors, which have expanded the fastest internationally (Narula and Duysters 2004). Strategic alliances refer to inter-firm cooperative agreements which are intended to affect the long term product-market positioning of at least one partner (Hagedoorn in Narula and Duysters 2004:201). Alliances and networks have now come to be the first-best option in the last two decades. Agreements are not primarily made to overcome market failure, but alliances also contribute to horizontal integration. For a long time these activities have been used mostly in countries such as Japan, but now most advanced industrial countries find this partnership attractive. International strategic technology partnering (STP) can involve universities, consortia, licensing, customers and suppliers, acquisitions, joint ventures and alliances and commercial research organizations (Narula and Zanfei 2005).

The current development of international R&D seems to be increasing. UNCTAD (2005) estimates that MNEs are responsible for about half of the global expenditure on R&D, and at least two-thirds of the business spending on R&D. These numbers

even surpass the R&D spending of some countries. Firms spent an average of 28% of their R&D budget abroad in 2003.

Clausen (2009a; 2009b) investigates if public subsidies have positive impacts on R&D and innovation activities at the firm-level. His empirical findings indicate that research subsidies stimulate R&D spending within the firm, while development subsidies actually substitute such spending. There appears to be support for the market-failure argument, that is, private R&D expenditure is best stimulated where the gap between the social and private return to R&D is high.

A global R&D network can create new powerful innovations and sustain competitive advantage. Increased complexity and costs may reduce the speed of these developments (Boutellier, Gassman and von Zedtwitz 2008). Global innovation networks are considered a crucial part of the international economic system. International sales, for instance export or setting up FDI, is usually considered the first step in the internationalization of a firm. One incentive for setting up local R&D is to adjust the product or service to local demands and needs. In the latter years, cross border mergers and acquisitions have been responsible for the most of the transformation into global R&D networks.

MNEs are undoubtedly the most important actors in the worldwide generation of technology and innovation (Archibugi and Iammerino 1999:324). Barriers to international R&D can be analyzed along two dimensions, the centralization and decentralization of technology (Narula and Zanfei 2005). The main advantages of centralization refers to economies of scale and scope in the R&D process, control on linkages and innovation with the local environment. The main advantages for decentralization are the linkages between innovative activities and local production, markets, suppliers and clients, and the benefits of technological competence and talented labor in the host country. These barriers are investigated in the survey.

Carlsson (2006:61) investigates the internationalization of national innovation systems, and notes that R&D is less internationalized than other corporate activities, although the R&D activities of multinational firms are increasingly being carried out away from their traditional home base. More recently, the desire to acquire technology has been a major motive for multinational firms to locate R&D facilities abroad. Baldwin and Gu (in Greenaway and Kneller 2007:150) report that Canadian exporters used more foreign technologies, were more likely to have R&D collaboration with foreign firms and improved the flow of information about foreign

technologies to Canadian firms. That also led to increased innovation and investments in absorptive capacity (Cohen and Levinthal 1990).

There is an increase in the internationalization of global R&D (Dos, Wilson, Veldhoven, Goldbrunner and Altmann 2006). Between 1975 and 2005 the share of R&D sites located outside the markets of their corporate headquarters rised from 45% to 66%. Several factors contribute to this development. There has been raising costs in the West of conducting R&D. At the same time, there has been a rapid growth of markets in developing nations and an advanced use and diffusion of information technology. There has also been a scarcity of engineers and education within the natural sciences in the industrialized world. Decision to locate R&D will be based on access to local markets, proximity to (new) technology and research clusters, markets and customers as well as qualified workers.

Research and development activities require intensive communication and close, informal collaboration. There is a rise in technological competence in developing countries, which increases the motivation for locating R&D abroad (Boutellier, Gassman and von Zedtwitz 2008). The legal conditions and restrictions for technology development may be less stringent in development countries. Biotechnology, genetics research and animal testing are controversial in the European Union. Political uncertainty regarding future legislation may increase the relocation of R&D to emerging knowledge clusters and markets. Furthermore, companies are tempted to invest in local R&D infrastructure and R&D sites due to imposed import and export quota, market entry barriers, tolls and standards.

Other issues relate to the reduction of product cycle time and concentration on core competencies and benefits through knowledge management. One of the most striking features is the shift of R&D activity from the manufacturing sector and into the service sector (Boutellier, Gassman and von Zedtwitz 2008:23). Even within traditional manufacturing, R&D resources seem to be geared towards services and information technology, or to summarize: “The internationalization of R&D is driven in part by the external pull forces of access to markets and new technologies, and in part by internal push forces of cooperation and competition, and global integration and local autonomy” (Boutiller et al. 2008:31).

In 2002, European companies performed about one third of their R&D outside their home country (Boutellier et al. 2008:43). Acquiring innovative firms is a strategy for gaining quick access to new technologies. This is reflected in the increase of cross-

border mergers, although some of these do not have a R&D related focus. Synergies in managing complex several R&D facilities will become more important in the decision to internationalize the R&D function, since the growth in mergers and acquisitions and cooperation are expected to increase even more in the years to come. Nations play a key role in providing infrastructure, facilities and resources for successful location of R&D and innovative capacity (Archibugi and Michie 1995:138).

Belderbos, Carree and Lokshin (2004) analyze the impact of R&D cooperation on firm performance in Dutch companies, based on CIS data from 1996-98. They differentiate between four types of R&D partners: competitors, suppliers, customers, and universities and research institutes. Two performance measures are used, labour productivity and productivity in innovative sales, measured as new to the market. The results confirm a major heterogeneity in the motivations and purpose of R&D cooperation.

International R&D is not just success stories, there are failures as well. Lhuillery and Pfister (2009) report results that indicate a 14% failure rate in R&D cooperation. These failures take place when the firms have to abandon or delay their partnership in innovation projects. Especially when having R&D collaboration with foreign partners, the firms report even higher failure rates for cooperation with competitors and public research organizations. The same goes for cooperation with suppliers, which also endure higher risks of cooperation failures. Previous experience in the partnership, larger organizations (size) and group subsidiaries also encounter reduced risks.

One type of barrier is illustrated by the innovation system literature. The location of a firm's R&D is a slow moving process. The reason seems to be the complex relationship with suppliers, customers and the knowledge infrastructure through formal and informal institutions, which may have taken years to develop (Narula and Santangelo 2009:394). Physical or geographical proximity makes knowledge transmissions more feasible. The local system may provide a combination of factors that contributes to innovation, such as skills, finance, production and user-producer linkages. If this is in place, the fear of knowledge spillover to competing firms may be counterbalanced and the location abroad may be conceived as attractive, or at least worth the increased risk.

2.1.3 Globalization of Innovations

Archibugi and Michie (1995) and Archibugi and Iammerino (1999) originally introduced a new taxonomy on the globalization of technology and innovation. This work is highly cited, and remarks one of the first attempts to classify different international activities related to technology. This taxonomy consists of tree parts, intended to capture the concept of "techno-globalism", which is used to describe the phenomenon of "globalization" experienced by the world of invention and innovation. The term is used to illustrate the fact that the generation, transmission and diffusion of technologies are increasingly international in scope. They analyze the role of MNEs in a global setting and the trends of internationalization and innovative activities. Before the introduction of this taxonomy, all the different internationalization channels were simply just referred to as "techno-globalisation" (Archibugi and Michie 1995:138). The authors presented a new classification of how multinational firms choose to organize their innovative activities, and separate three main types of phenomena in the internationalization and globalisation of innovations. They identify three categories of how the globalization of innovative activities in MNEs could be perceived. It should be noted that each of these channels are related to the previous section on the internationalization processes of firms, and the questions asked in the survey.

The first group is *the international exploitation of nationally produced innovations*, and includes the exports of innovative products and services, and foreign direct investments (FDI) that involve the production of innovative goods and services created in the host country. These are actually the oldest forms of cross-border diffusion of innovations and represent internationalization rather than actual globalization. The survey asks questions about international sales, measured as export and FDI. This also corresponds with the literature review on export and FDI in section 2.1.1.

The second group is *global techno-scientific collaborations*. In recent times there has been an increase in collaboration of this kind among private companies (Archibuggi and Iammerino 1999:243-6). The more advanced MNEs also search out relations with leading research institutions in the world (Toivonen 2004:85). This type of cooperation includes strategic joint ventures and strategic technology partnering, as illustrated by Narula and Zanfei (2005). The survey investigates if the respondent has international cooperation and international innovation cooperation (questions 13 and

17).

The third group is *the global generation of innovations* and refer to the development of firm based strategies in research and technology across different countries for generating innovations through the development of global research networks. This is possible and attractive given the new information networks. Innovations emerging in MNEs are authentically global from the first moment, and MNEs are responsible for a major part of industrial R&D and patents spread in foreign markets. Narula and Zanfei (2005) see the MNE as the only institution that is able to carry out and control the global generation of innovations within its boundaries. One empirical finding is that even though most MNEs have internationalized their innovative activities, most R&D activities are still concentrated in the respective home country of the MNE, and some few host countries. MNEs have been considered to play an especially important role in the internationalization of innovative activities (Toivonen 2004:85). On the other hand, empirical results describing the behaviour of MNEs show that these enterprises still have, in most cases, a clearly identifiable home country, where innovation activity is concentrated. The tendency to conduct innovation in a decentralized way in other countries are only slowly increasing. Given these results, many researchers are reluctant to speak about the emergence of innovation systems on an international or global scale, despite the internationalization of innovation activities. Internationalization seem to manifest itself in a number of ways in innovation activities (Toivonen 2004:84).

Narula and Zanfei (2005:326, 332) see the slow development of having international R&D in relation to the complex nature of the national innovation system and the close integration of the MNE in the home environment. Firms may require development of new technology faster than the national innovation system can provide. In order to compensate for this, especially for rapidly evolving sectors, firms may seek abroad for that specific knowledge.

However, Carlsson (2006) presents a survey of the literature on the internationalization of innovation systems. While there is a large literature on the internationalization of economic activity (including R&D) at the corporate level, he does not identify many studies of the degree of internationalization of innovation systems. According to his survey, the few studies that exist show that national innovation systems are becoming more internationalized, even if the institutions that support them remain country-specific. To the extent that the far more numerous

studies on internationalization of corporate R&D discuss innovation systems at all, they point to the continued importance of national institutions to support innovative activity, even though the activity is itself becoming increasingly internationalized.

The idea with this taxonomy is to find a way to scientifically investigate the differences between globalization of innovations. The Service Internationalization Survey (SIS) only targets Norwegian service firms, and therefore my focus will be on the firm as unit of analysis. The questions asked in the survey correspond to the three classifications developed by Archibugi and Iammerino (1999). The survey focuses on three internationalization channels: international sales (export and FDI), international cooperation and R&D abroad. The idea is to use this taxonomy of the globalization of innovations as a measure of Norwegian service firms internationalization and innovation activities.

Firms are expected to follow different patterns according to each of these classifications. The authors find that the first category is becoming more important and grows, while the second category is also increasing, but not so much as the first. The third classification is more stable, but experiences some growth. In the future, this channel is expected to grow considerably, as the world's demand for even more complex innovations grow. When these categories are transformed into questions in the survey, the hypothesis will expect the same developments in the Norwegian service sector. Even more so for services, since they are somewhat harder to trade compared to manufacturing. In the service sector, firms will be expected to have service innovations, and their propensity to trade and exploit the innovations internationally is expected to continue.

Table 2.1 A taxonomy of the globalization of innovations

Categories	Forms
International exploitation of nationally produced innovations *Survey: International sales (Export/FDI)*	Exports of innovative goods and services. Cession of licenses and patents. Foreign production of innovative goods and services internally designed and developed
Global techno-scientific collaborations *Survey: International Cooperation* *Survey: International Innovation Cooperation*	Joint ventures for specific innovative projects. Productive agreements with exchange of technical information and/or equipment.
Global generation of innovations *Survey: R&D abroad*	R&D and innovative activities both in the home and the host countries Acquisitions of existing R&D laboratories or green-field R&D investment in host countries

Source: Based on Narula and Zanfei (2005) and Archibugi and Michie (1995)

2.2 Service Innovation and Internationalization of Services

Service innovation and the internationalization of services are topics of growing interest for researchers and policy makers. Services have grown to constitute the larger part of employment and output in most industrial countries. The service sector of industrial countries is important for their productivity, economic competitiveness and quality of life (European Monitoring Centre on Change 2005; Miles 2005). There has been an unprecedented growth of FDI in services, increasing from 950 billion dollars in 1990 to 4 trillion in 2002 (UNCTAD 2004 in Helpman 2006:590). In 2002 services accounted for two-thirds of FDI inflow. International trade in services constitute more than 30% of total trade and around 60% of FDI in the OECD area seem to be directed towards service activities (Grünfeld and Moxnes 2003). This also implies an increased competition for service markets. OECD data show that service industries in advanced countries are responsible for about 30% of total R&D conducted in the business sector, and even account for more than 50% of R&D in intermediate inputs and capital equipment (Cainelli, Evangelista and Savona 2006:436).

The economic importance of services suggests that improvements in European living standards are likely to depend more on productivity improvements in the service sector than in manufacturing, according to the European Innovation Scoreboard (2007). This has been the case in USA, where services contributed three-quarters of the increase in productivity after 1995. Much of the productivity increase is due to different types of innovation, developed both in-house and by service firms and from service firms adopting productivity enhancing innovations such as ICTs (Sapprasert 2007).

Researchers have proposed several explanations to the growth of the service industry. One explanation may be the income elasticity of the consumption of services relative to manufactured goods (Gregory et al. in Castellacci et al 2009). When countries experience economic growth, in terms of increased GDP per capita, people tend to prefer more consumption of services relative to that of manufacturing, for instance better health care, more exclusive restaurants and faster telecommunications and more leisure time. Another argument is the outsourcing argument. The idea is that services are being outsourced from the manufacturing industry, and then become visible in statistics. Services that previously supported the production of manufacturing goods, are now outsourced in order to let the company

focus more on its core competencies (Prahalad and Hamel 1990). In other words, there is an observed reallocation of existing activities, rather than a real process of structural change and creation of new services. Services may have become so complicated and independent in their own right, and therefore reflect the "knowledge-based productive process" (Fixler and Siegel in Castellacci et al. 2009:25).

Economic development has made services an important part of national economies (Miozzo and Miles 2002). Technological change has now been integrated with services, as they more and more consume developments within ICTs (Evangelista 2000; Sapprasert 2007). Globalization has made many services go global as well (Aharoni and Nachtum 2000). Patel (in Carlsson 2006:60) argues that the largest increase in internationalization has occurred as a result of mergers and acquisitions (M&A), and not by means of organic growth. Patent activities indicate an increase in the international activities undertaken by foreign firms.

There has also been a strategic deregulation of some sectors. For instance, financial services, air transport and telecommunications has experienced an international expansion. This has also helped to provide the necessary infrastructure for the internationalization of other industries (Miozzo and Miles 2002:25). Regional initiatives, such as EU's internal market and the North America Free Trade Agreement (NAFTA) have intensified the internationalization of services in specific areas. Globally the General Agreement on Trade in Services (GATS) has aimed to further liberalize services and internationalization expansion. Domestic and foreign competition policy can also be seen as tools to enhance and improve the quality in the service industries.

Barriers to internationalization of services may not be just the traditional policy related issues, such as regulation, sunk costs or external constraints, but even more the internal resources and ambitions of the firm, especially those that do not have any international activities. The importance of information technology in facilitating the internationalization of services could also be addressed (Miozzo and Miles 2002:9).

Most research within innovation studies have traditionally focused on innovation in manufacturing, and more or less neglected services. This has now changed, and research on innovation in services is now growing rapidly (Miles 2005; Gallouj and Savona 2009). Services must be consumed immediately, as it cannot be stored. The service provider then have to be located at the same place at the same time as the

consumer. This clearly has implication for the internationalization of services (Aharoni and Nachum 2000). This is often referred to in the literature as the “co-terminality of production and consumption” (Miles 2005).

Services are also intangible, as compared to products, which makes them harder to transport, store and export. Given the intangibility and information-based characteristics of services, the use and production of ICTs seem to be important and quite dominant in the service sector (Evangelista 2000). An intense process of customization and interactivity promote the close relationship between service providers and consumers. This often contributes to user generated innovations and “open innovation” (Chesbrough 2003). Services are typically interactive, involving high levels of contact between the service supplier and client in the design, production and delivery, consumption and other phases of the service activity (Miles 2005:435).

The economic motivation is interesting in itself, but services generate even more interest since they now extend beyond the service sector itself, and now affect all service activities in all sectors of the economy. Some groups of services also seem to play central roles during innovation processes throughout the whole economy, for instance as agents of transfer, innovation support and sources of innovation for other sectors (Miles 2005:434). Overall, the service industry is quite heterogeneous in nature, and carries out a plethora of different activities across sectors. In line with this, several taxonomies have been developed to cater for these aspects (Pavitt 1984; Evangelista 2000; Miozzo and Soete 2001; Castellacci 2008). The proposed taxonomies, as described later in this chapter, also makes it possible and easier to collect relevant data and analysis.

The traditional attitude to innovation in services is that services either are not innovative or simply just innovation laggards (Malerba 2005:383-8). Sometimes services are referred to by what they are not. This negative description is also why services enjoy such a negative reputation at times. Prolonging this argument, defining the service sector may seem quite a challenge as well. According to Nahlinder (2005:20) we find a tension between the ideal type of services and how services actually are. Regardless of this, a massive literature on services have demonstrated that services are innovative, but differs according to different service sectors (Evangelista 2000).

Gallouj and Savona (2009) make a distinction between three theoretical approaches

to innovation in services: assimilation, demarcation and synthesis. All three approaches agree on innovations in services being important, but their conceptualizations of innovations differ. The assimilation approach considers innovation in services much as innovation in manufacturing, while the demarcation approach argue that due to the peculiarities of service products, innovation in services differ from innovation in manufacturing. Services must therefore be treated as something that is different. Supporters of this perspective also tend to focus on differences between service sectors and manufacturing sectors, and not on the difference between service industries. The synthesis approach recognizes that innovations are taking place in service sectors, and they may differ from innovations taking place in manufacturing sectors, and that findings on innovation in services may enrich the concept of innovation in manufacturing.

Despite the consensus on some of the characteristics of innovation in services, there are still two challenges to overcome (Evangelista 2000: 189). First, the fact that most services are heterogeneous in their nature makes it hard to make any stylized generalization. Secondly, the still ongoing process on convergence between manufacturing and services makes the traditional divide between these two sectors even more meaningless. However, it is still beneficial to have a basic assumption of what constitutes service innovation.

Even with the current knowledge and state-of-the-art statistics, there are still less detailed and comprehensive data on services, as compared to manufacturing, especially on the topics that are to be investigated in this thesis. Few available innovation indicators were designed with the intention to measure services, and we may therefore not have a proper understanding of the dynamics of service innovation (Miles 2005:447). Many researchers emphasize the need for a more general framework that could be used to analyze innovation processes irrespective of their manufacturing or service background. The sectoral taxonomy provided by Pavitt (1984) and later refined by Castellacci (2008) is one such general framework.

R&D is usually not the most common or important source of innovation in services. Acquisition of machinery and equipment, external technologies and training of human resources are some of the more innovation related activities that are undertaken. Technology adoption in services is clearly a dominant innovation strategy (Tether in Miles 2005:448).

Research on the economic performance of service innovation has been much more

limited (Castellacci et al. 2009:28). The reason seem to be methodological and conceptual difficulties. The dynamics of productivity in manufacturing has been fairly covered in innovation studies. However, the same studies are missing regarding the service sector. It is a likely assumption that ICTs have had a positive impact on innovation and productivity in services, as noted by Evangelista (2000) and Sapprasert (2007). Service output is hard to measure, due to the intangibility and heterogeneous nature of services. Customisation and flexibility in accordance with the users' needs, as well as challenges by using standard definitions to measure quality changes, makes it more difficult to measure the output of innovation in services.

The understanding of productivity of services has implications for international competitiveness. The variation of innovation in services has been investigated, but the economic impact has been ignored, especially for firm-level analysis. There seems to be a gap in the literature on innovation and competitiveness of service sectors. Lack of relevant data seem to be one justified reason, as well as conceptual issues. The latter refers to the complex phenomena of correctly measuring the specific characteristics of service activities. Previous studies indicate that innovation is a key dimension in understanding the determinants of international competitiveness in services. Based on that literature, it is crucial to investigate …"the intensity and the direction of inter-sectoral linkages and exchanges of advanced knowledge between different groups of service and manufacturing activities" (Castellacci et al. 2009:31).

Cainelli, Evangelista and Savona (2006) explore the two-way relationship between innovation and economic performance in services. They point to a gap in the literature on several occasions. They find that innovation is clearly positively affected by past economic performance and innovation activities have a positive impact on growth and productivity. Even more, innovation and productivity can be seen as a self-reinforcing mechanisms that increase economic performance. The authors refer to three mechanisms explaining the link between innovation and economic performance at the firm level. The first mechanism sees innovation as a determinant of economic performance, also labelled "Schumpeter 1". Several studies investigating the manufacturing sector has uncovered positive effects of innovation on economic performance and especially productivity. This thesis aims to investigate whether this link is present in the service industry as well. The second mechanism refer to economic performance as a determinant of innovation activity, also labelled

"Schumpeter II". Large innovation projects are costly and risky, and are associated with firms that have high growth rates, large profits and a healthy cash flow (Cainelli et al. 2006:438). There is an established link that economic performance contributes to the probability of having more innovative activities. However, it is still to be tested whether these assumptions hold for the service industry. Innovation in services is usually informal and less reliant on technological progress. This may reduce the effect of previous economic performance on the innovation activity. Some service sectors, such as finance and telecommunications are associated with a more developed technological infrastructure. This illustrates why it would be interesting to investigate sectoral differences as well, and a taxonomy of sectoral patterns of innovation is introduced later in this chapter and tested empirically.

The last mechanism is a two-way dynamic link between innovation and economic performance, which is in line with the evolutionary economics paradigm. In this version, these two factors are interrelated and cumulative, and may not be empirically isolated, since they operate as one. This idea departs from an economic and technological context illustrated by bounded rationality of actors, high uncertainty and path dependency. In such an environment, innovation is the most important competitive foundation for firms. The main source for research within this field have been case studies and qualitative evidence (Cainelli et al. 2006:440), and the literature has mostly focused on the evolutionary trajectories of manufacturing, and rarely so for services and endogenous technological change.

Other issues of firm-level competitiveness refer to the link between innovation, export labour productivity. These links have been investigated in relation to manufacturing, and part of this literature is refreshed in Section 2.1.

2.3 A New Taxonomy of Sectoral Patterns of Innovation

Based on the reviewed literature, there is a need for a taxonomy to measure the sectoral differences and internationalization patterns in the Norwegian service sector. This thesis will benefit from previous taxonomic exercises done by Pavitt (1984), Miozzo and Soete (2001) and Castellacci (2008). Based on sectoral patterns of change, Pavitt (1984) introduced a taxonomy and theory investigating characteristics and variation in firms. The sectors were compared in terms of (1) the sectoral sources of technology used in a sector; (2) the institutional sources and nature of the technology produced in a sector; and (3) the characteristics of innovating firms (e.g. size and main activity). Based on these criteria, he identified four categories of firms: supplier dominated, scale intensive, specialized suppliers and science based. A further description will not be given here, since the main focus in the thesis is based on a refinement of this original insight.

Archibugi (2001) reviewed this taxonomy 16 years later. The idea with taxonomies, which dates back to Aristotle, is to reduce complex phenomena into classifiable categories, and maximize the difference among groups. The new idea from Pavitt was to classify firms based on their technological competence. Another competing, and often used classification, is based on technology and R&D intensity. It places firms into high, medium and low technology-intensive industries (see for instance von Tunzelmann and Acha 2005). Based on this categorization, the firms will derive specific characteristics depending on their location in the hierarchical system.

Motivated by a technological perspective on the internationalization of services, Miozzo and Soete (2001) outlined a taxonomy of services based on their technological linkages with manufacturing and other service sectors. Pavitt (1984) located all services as supplier-dominated (one of the four categories he identified). Services were not considered to be very innovative, since they received most of their input from science based and scale intensive firms. However, based on the origin and application of technical change, Miozzo and Soete (2001) identified three (new) groups: (1) supplier-dominated services; (2) scale-intensive infrastructural services (physical and information network infrastructure of the knowledge economy); and (3) science based and specialized suppliers sectors, also called the knowledge intensive business services (KIBS). These groups were later refined and developed by Castellacci (2008).

Pavitt's taxonomy was originally designed to cater for manufacturing industries, but the same classification can somewhat be expanded to cover innovation in the service industry. According to Evangelista (2000), software and extensive user-producer interactions seem to be the most crucial differences between innovation in the two industries. He has also added a category of "Interactive and Information Technology based companies", and by making this classification, it is now possible to operate with one taxonomy that includes both manufacturing and services.

Manufacturing and services represent closely intertwined parts of the same economic system. The knowledge flows and connections between the two industries are becoming increasingly important (Castellacci et al. 2009:68). It is therefore necessary to facilitate an integration of the two research agendas. Such an attempt has been conducted by Castellacci (2008), who put forward a new taxonomy of sectoral patterns of innovation and discussed its theoretical foundations and main properties. The sectoral taxonomy combines elements of sectoral classifications previously pointed out in the economics and innovation studies literature. The economics literature has frequently adopted a product related type of classification, where industrial sectors are identified according to the kind of item that firms predominantly produce and commercialize. On the other hand, the literature studying innovation has frequently adopted sectoral classifications that point out more explicitly the characteristics of the process of technological change, rather than the types of items produced by firms in various sectors. One type of this classification scheme is the well known taxonomy by Pavitt (1984), where the main focus is on the innovative mode adopted by different sectoral groups and the related inter-sectoral knowledge flows.

Since this thesis only aims at investigating the Norwegian service sector, it is sufficient to only present the parts of the taxonomy that describe the service sectors. For a complete overview of the whole taxonomy, see Castellacci (2008), since it is important to understand the function of other groups in the economic system, e.g. in terms of how they complement each other.

Advanced knowledge providers (AKP) are located at the earliest stage of the vertical chain, and are characterized by great technological capability and a significant ability to manage and create complex technological knowledge. This group includes providers of specialized knowledge and technical solutions like software, R&D, engineering and consultancy, usually referred to as business services.

According to Castellacci (2008) they represent the supporting knowledge base upon which all other sectors are built, and they continuously upgrade and renew this base. Firms in these industries are typically small, and tend to develop their technological activities in close cooperation with their clients and with users of the new products and services they create. In more recent times, the greater technological specialization and deeper division of labor have increased the demand for complex innovative capabilities, leading to the emergence and rapid growth of this group, which now act as providers of specialized knowledge and technical solutions for the other advanced branches of the economic system (Castellacci, Karpaty, Laursen and Tingvall 2009:37).

Another name identical to the group of advanced knowledge providers are known as "knowledge intensive business services", or simply by the acronym KIBS. This group have received much attention in the literature on services (Miles 2005; den Hertog 2001; Nahlinder 2005) and several public documents and reports have stated their importance for economic growth and diffusion of innovations, such as the European Innovation Survey (2007) and the European Monitoring Center on Change (2005). Innovation research has in three ways contributed to the understanding of how KIBS function in the economy; the new conception of the nature of innovation activity, the innovation systems approach and research into service innovation (Toivonen 2004). Particularly relevant for KIBS is that the innovation activities are linked to learning, and especially learning by doing, learning by using and learning by interacting. KIBS play an important role as supporters of innovation in other companies or as co-producers of innovation (den Hertog 2000).

They are also important innovators themselves, which is a fairly new insight. KIBS play central roles in innovation processes throughout the economy, as agents of transfer, innovation support and sources of innovations for other sectors. Technology based KIBS are among the most active innovators in the economy, as indicated by the Community Innovation Surveys 3 and 4, and other statistical data (Nahlinder 2005; Toivonen 2004). KIBS are services and business operations heavily reliant on professional knowledge, and they are mainly concerned with providing knowledge intensive support for the business processes of other organizations. KIBS sectors are characterized by the proportion of their employees who are highly skilled. According to the European Monitoring Centre on Change (EMCC 2005), about 16 million workers in Europe are in the KIBS sectors. The growth of KIBS reflects growing demands for knowledge to deal with change, both technological and social, and also

the growing interaction among firms in innovation activities.

Based on the above literature, the long established growth trend of KIBS can be expected to continue and the significance of internationalization is growing and the forms of international activities are diversifying. One surprising finding is the promising fields for innovation activities in non-technical KIBS, which earlier on has been studied to a small extent. KIBS play an important role in improving the innovation and export performance of small to medium sized enterprises, which are dependent on KIBS for support and to be successful in their international performance, such as exporting or international cooperation. The role of KIBS as intermediaries between public sector research organizations and business is profound and increasing as well, as stated by the European Monitoring Center on Change (2005). KIBS are also particularly important in assisting the formation and survival of new firms that are exploiting technological or market-based opportunities. Overall, the literature suggest that KIBS may be an important focus for analysis and policy. In the thesis, KIBS will be referred to as advanced knowledge providers (AKP), and this will be the unit of analysis. This is to keep a consistent use of terms and taxonomies throughout.

Network infrastructure services (NIS) and **Physical infrastructure services (PIS)** are also located at the early stage of the vertical chain, which is similar to the previous category presented above. These two groups mostly produce intermediate products and services rather than items for personal consumption, which is located in the other end of the vertical chain (personal services). They differ from the group of advanced knowledge producers in terms of technological capability, especially regarding their more limited ability to develop knowledge internally, in terms of advanced research and development and knowledge management. Their dominant innovation strategy tends to be based on the acquisition of machinery, equipment and various types of advanced technological knowledge created elsewhere in the economic system, for instance by advanced knowledge providers. Two distinct sub-groups of sectors can be found here, each characterized by a different level of technological sophistication (Miozzo and Soete 2001). The first sub-group constitute providers of distributive and physical infrastructure services (e.g. transport and wholesale trade), and the second sub-group constitute providers of network infrastructure services (such as finance and telecommunications). Firms in the latter group typically make heavy use of ICTs developed by other advanced sectors in order to increase the efficiency of the production process and the quality of their

services, whereas the former group of industries has significantly less capability in this respect. Regardless of these differences, these sectoral groups share the same function in the economic system. Business and innovative activities carried out by firms in the whole economy are based on the supporting infrastructure service. Within the domestic economy, intersectoral knowledge diffusion will be easier when the supporting infrastructure service is more advanced. The national system will be more efficient and productive as well (Castellacci et al. 2009:38). Both these groups will be independently analyzed in the empirical part (see Chapter 4).

The fourth and last category include **personal services (PGS)**. They are located at the final stage at the vertical chain, since they provide final services to consumers. These service industries are characterized by a lower technological content and a more limited ability to develop new services and processes internally. Their dominant innovation strategy is therefore to acquire machinery, equipment and other types of external knowledge produced by their suppliers and the infrastructural services. They clearly lack the ability and resources to organize and maintain their own R&D labs. This explain the term supplier-dominated industries that is frequently adopted in the innovation literature (Pavitt 1984; Miozzo and Soete 2001). These firms are typically small enterprises and mostly recipients of advanced knowledge. To the extent that they are able to implement new technologies created elsewhere in the economy, they may use them to increase the efficiency of the production process as well as to improve the quality of the final services they commercialize. This type of strategy may help to lengthen the industry-life cycle of these mature industrial sectors and recreate new technological opportunities (Castellacci 2008).

The four groups belonging to manufacturing will not be used in the empirical exercise, and are therefore not presented here. Overall, this taxonomy presents a stylized view of some of the main vertical linkages between manufacturing and business services within a national system of innovation. This thesis will benefit from using this well developed taxonomy, and it facilitates a better analysis of the phenomena that is to be investigated, namely innovation and internationalization in the Norwegian service industry.

2.4 Research Questions

The literature on firm level export performance and the literature investigating sources of innovation and technology (Pavitt 1984; von Hippel 1998) have not been combined (Laursen 2008). Typically, the export performance literature seem to have mostly focused on manufacturing firms, rather than on services, even when many service firms are becoming increasingly global (Aharoni and Nachtum 2000; Miozzo and Miles 2001). One way to bridge this gap is to introduce taxonomies of innovating firms in a trade context (Laursen 2008:7). Other literature has dealt with sources of innovation, and Beise-Zee and Rammer (2006), is one of few studies that combine the two strands of literature. With a few notable exceptions the literature on firm-level export behaviour tend to focus on manufacturing. Another gap in this branch of the literature regards the connection between innovation and internationalization, which is seemingly under-explored at the present time.

Many of the contributions on innovation in services have evolved independently from research on the internationalization of services and the globalization of economic activity (Miozzo and Miles 2002:22). Since the growth of services is integrated with manufacturing, as illustrated by the taxonomy developed by Castellacci (2008), services should be analyzed and interpreted within the context of changes in the way production is carried out. Deregulation, liberalization and the impact of new information and communications technology have intensified the growth of services (Miozzo and Miles 2002:24).

There have been empirical challenges to old and new trade models (Bernard et al. 2007). Confronted by empirical evidence, there is now a large literature investigating firm level heterogeneity. Due to the increase in economic globalization and export and FDI, new trade theory, confronted by large firm level data sets, has started to investigate firm level heterogeneity. This allows for firms to have firm-specific characteristics, which was not possible or appropriate in the old trade models. After reviewing the literature on export and FDI, and the new developments within trade theory, there seems to be several gaps in the literature: first, services are under-investigated, or neglected, and the relation with innovation seem to be blurred or absent. Thirdly, other internationalization channels are not so well investigated.

This chapter has illustrated that most of the literature on innovation and international performance has focused on manufacturing, and neglected or marginalized the

service sector. Statistics and research on international trade have also pointed out the growth and economic importance of services, while innovation and sectoral differences have been left alone and not been integrated. It is therefore a plausible idea to further investigate these phenomena by combining the different strands of literature and test some of these assumptions empirically in a Norwegian context. One of the main factors that have slowed the progress in this field has been the lack of reliable data and empirical evidence to complement the proposed theoretical contributions. Motivated by this gap in the literature on innovation and internationalization of services, the following research questions will be investigated end tested empirically:

- **What characterizes innovation and internationalization in services?**

  As the literature has illustrated, there are good reasons to expect innovations to take place in services. Based on statistical appraisal and updated numbers, services are also expected to be increasingly international. However, international performance will not be the same on all the internationalization channels that are to be investigated. The previous literature has pointed out that international sales (export and FDI) will be more important and more widespread than international cooperation and research and development (R&D) abroad. Descriptive statistics of the collected sample will be carried out to investigate the presence of these phenomena.

- **How do different barriers affect this link?**

  Barriers to internationalization, or simply sunk costs, will reduce the probability of firms to increase their international activities. Some barriers are expected to be more important than others, while others might not affect the internationalization at all. The barriers are illustrated by descriptive statistics and regressions (logit model), where the different barriers act as explanatory variables.

- **How does this relationship differ among service industries?**

  The barriers to internationalization will have different impact on the various service industries. The share of firms with international sales and introduction of new services (innovation) are also expected to be different. Different sectoral patterns of innovation and internationalization of services are expected to take place. The presented taxonomy of sectoral groups will be tested empirically in the analysis of variance (ANOVA) and by using dummy variables in the regressions (logit model).

To test these assumptions empirically, it was necessary to collect some data on the Norwegian service economy and survey their innovative capabilities and international presences. This is presented in the next chapter.

3 Research Methodology, Data Collection and Descriptive Statistics

3.1 The Questionnaire: Ideas, objectives and relation to the theory and the research questions

The previous chapter pointed out a gap in the literature on the relationship between innovation and internationalization of services. The existing literature has mostly focused on manufacturing, and rather ignored the service sector. The lack of data material to investigate these issues, raised a need to collect fresh survey data. This chapter describes the chosen research methodology and the questionnaire that was send out to the respondents, as well as the experience gained during the data collection process. In order to prepare an investigation of sectoral differences, the service sector respondents and the corresponding NACE classifications are classified into one of the four sectoral groups in the taxonomy. In the end, the empirical results are presented in seven tables containing descriptive statistics.

The survey was web-based and contained 25 questions about firms' international activities in the period of 2004-2006 and covered three internationalization channels: international sales (exports and FDI), international cooperation and international R&D. For each channel the survey asked questions on their delivery mode, type of partner, motives and objectives, as well as the geographical area and barriers to internationalization. The survey is attached in Appendix A.

The theoretical base for designing this survey has been the well known taxonomy "globalization of innovations" (Archibugi and Michie 1995; Archibugi and Iammarino 1999). This taxonomy was described in detail in the previous chapter. Other previous surveys have also been used to shape and specify the questions in the survey. The most important questionnaire is the one used for the Community Innovation Survey in 2002-2004, based on the UK National Statistics and Statistics Norway. A survey on the internationalization of Danish enterprises from Statistics Denmark in 1996 was also used as an inspiration for designing the survey.

3.2 The Service Sector, NACE Classifications and Sectoral Taxonomy

The service sector is composed of many subgroups and their corresponding NACE classifications. The basic idea is to split the different NACE classifications according to their group in the taxonomy. By doing this simple categorization, it is possible to investigate the group differences, for instance by doing an analysis of variance (ANOVA). Chapter two pointed out that heterogeneity in service industries exists, but there is still lack of empirical evidence to support these theories, especially in relation to internationalization and innovation. By using the developed taxonomy by Castellacci (2008), it is possible to further investigate the sectoral patterns of innovation and internationalization in services.

Table 3.1: Statistical Classification of Economic Activities and Sectoral Taxonomy (NACE revision 1.1)

NACE classification	Description of economic activity
Advanced Knowledge Providers (AKP)	
72	Computer and related activities
73	Research and development
74	Other business activities
Network Infrastructure Services (NIS)	
64	Post and telecommunications
65	Financial intermediation
66	Insurance and pension funding
67	Activities auxiliary to financial intermediation
Physical Infrastructure Services (PIS)	
51	Wholesale trade and commission trade
60	Land transport (including pipelines)
61	Water transport
62	Air transport
63	Supporting and auxiliary transport activities (including travel agencies)
Personal Services (PGS)	
50	Sale, maintenance and repair of motor vehicles and motorcycles
52	Retail trade, repair of personal and household goods
55	Hotels and restaurants

3.3 The Data Collection Process

The collected data used in this thesis is found in the Service Internationalization Survey (SIS) at the Norwegian Institute of International Affairs (NUPI), and includes a total of 814 firms. It contains data collected in three phases. The first and initial phase collected responses from about 300 firms, and was conducted in 2008 by Astrid Lyse (research assistant). During this first phase, a minor part of the data collection was done through phone interviews, but with the same questionnaire and a few adjustments. The second and largest phase was conducted by myself and collected responses from about 500 firms in the period of May - August in 2009. One third and minor phase was conducted in late August 2009 as well. Its purpose was to supplement the data collection with some larger firms that were not listed with an e-mail address in the Statistics Norway register (SSB). These e-mail addresses were found by searching the web pages of the selected companies. Overall, this last phase collected some few, but important firms to strengthen the data collection. The results of the data collection is presented in Table 3.2 in the next subsection.

All the data has been collected through the use of a questionnaire and a software called Mamut Online Survey. The complete questionnaire is attached in Appendix A. The software was programmed to send out questionnaires to selected firms and their e-mails. If an invited firm did not respond after the first invitation, they would receive another e-mail encouraging them to fill out the survey. During the data collection two reminders were sent, but not more, to avoid spamming the invited firms.

The selection process included the following steps:

1. All firms were selected from the “Bedrifts- og Foretaksregister”, provided by Statistics Norway (SSB). The firms were then split into the different NACE sectors, with a total of 15 industries, which correspond to the four constructed categories developed by Miozzo and Soete (2001), and later refined by Castellacci (2008a).

2. Firms with 10 or more employees in each NACE classification were selected.

3. Those listed with an e-mail address were selected.

4. Invitational lists were generated in the Mamut Online Survey software for each NACE sector, as presented in Table 3.1.

5. Firms with error mail, or other related reasons, were deleted and removed from the invited population.

6. A list of all the firms that completed the survey was made, with a total of 4230 invited firms and a response rate of 19%. These results and an overview of the data collection is provided in Table 3.2.

After this data collection process, there were three main sample categories. The first was the original sample with enterprises that suited certain selection criteria. That included selected firms with 10 or more employees listed with an e-mail address in the Statistics Norway register (SSB). The next sample was called the final sample and included enterprises in the original sample that were actually contacted and received the survey. Error mails, spam mails and cases where the firm was not existing were removed in this category. The last was referred to as the collected sample and included the responding firms.

Several e-mails from the invited firms were received during the data collection. The main types of feedback and approaches, and how the e-mail were answered, will now be mentioned. This is to give the reader an understanding of the experience gained during the process of collecting data, as well as some of the practical aspects of the chosen research methodology.

Many emails stated various reasons for not participating. Some implied the survey was not relevant, or it would take too much time and resources. Others asked not to be bothered, or had the wrong address and so on. These e-mails were treated

as non responding firms. When encountering “double e-mails”, meaning that the same firm would unfortunately receive the survey on two or more different e-mails, then only one response was saved and the other was deleted.

Some receivers considered the invitational mail from NUPI as spam, or too large to fit into the mailbox, or for other reasons have been moved to their trash. These mails are considered “error mail”, meaning they would not be counted as “not responding”, and therefore would not affect the answer ratio. The receiver would not have the opportunity to enter the questionnaire. Sometimes the firm or person invited into the survey no longer exist. This included the company going bankrupt, due to the financial crisis in 2008-2009 or other reasons. It also included cases when the invited person had ended their job or position in the firm. These respondents were therefore removed from the final sample, since they never had the opportunity to enter the questionnaire. Other firms mailed questions about the survey. Often “why have our firm been selected”, or, “we do not participate in surveys, due to company policy”. These e-mails were answered politely and the firm or person was encouraged to participate, repeating or giving the arguments as stated in the introduction of the survey. Those respondents would be treated as usual and counted into the final sample. Several firms also sent a personal e-mail and stated that the survey was not suitable for the company or gave other similar reasons. They rejected to complete and finish the survey. These were counted in the “not responding” category.

Other replies included receiving e-mails with a case number or the invitation that was send to the general administration. Usually the e-mail stated that the customer support will take care of the e-mail and be tracked. It was reasonable to assume these mails would either be deleted, or sent to the right person. Those respondents would be treated as usual and counted into the final sample. Finally, many e-mails were automatic replies from the receiver, stating they would read and reply to the survey at a later stage. It could include reasons such as the receiver being on holiday, out of office, leave of duty, being on sick leave, travels or business meetings. It was again reasonable to expect the e-mail to be read at a later time when the person got back in office. This could of course lower the response rate, but would still be less significant, given the total amount of invited firms. These respondents would be treated as usual and counted into the final sample. This also illustrated why reminders turned out to be quite effective.

3.4 Results of the Data Collection

Overall, the data collection process was considered successful with a reasonable high rate of respondents (19%), and provided a great foundation to start the descriptive and statistical analysis. The main results of the Service Internationalization Survey (SIS) is presented in subsection 3.5 and Tables 3.3 – 3.9. They include the reported descriptive evidence of the whole sample with 814 completed surveys.

Table 3.2 summarizes all the data collected in the Mamut Online Survey. The response rate was different for the various NACE classifications. Each NACE sector has it own characteristics. The group of network infrastructure services had the highest response rate (32%), and the group of personal services had the lowest (13%). One explanation could be that the first group is more international and innovative, and therefore were more likely to respond, while the latter is less so, and does not have a similar interest in participating.

The survey results are representative samples of the Norwegian service economy, in that they reflect the relative population of the various groups. It should be noted that the network infrastructure services (NIS) have a lower number of invited firms, but also a higher response rate. There are overall fewer firms in the economy that belong to this group, such as post and telecommunications, financial intermediation, insurance and pension funding and activities auxiliary to financial intermediation (see Table 3.1). The Norwegian economy is relatively small, and the firms in this group are usually few, but with many employees (see Table 4.1). The number of firms and respondents reflect this.

Table 3.2: Results and overview of the data collection: NACE Classification and Sectoral Taxonomy for each completed Mamut Online survey

NACE classification	Total invited	Respondents	Answer ratio
Advanced Knowledge Providers (AKP)			
72	328	62	0,19
73	18	9	0,50
74	963	221	0,23
	1309	**292**	**0,22**
Network Infrastructure Services (NIS)			
64	108	33	0,31
65	92	32	0,35
66	17	5	0,29
67	31	9	0,29
	248	**79**	**0,32**
Physical Infrastructure Services (PIS)			
51	856	165	0,19
60	252	48	0,19
61	116	24	0,21
62	6	1	0,17
63	227	41	0,18
	1457	**279**	**0,19**
Personal Services (PGS)			
50	255	33	0,13
52	594	90	0,15
55	367	41	0,11
	1216	**164**	**0,13**
Total	**4230**	**814**	**0,19**

3.5 Descriptive statistics

Table 3.3: General information about the firm

Variable	Observations	Mean	St. deviation
Employment	812	70.8	223.4
Part of a group	808	52%	0.49
Headquarters in Norway	771	82%	0.38
Turnover (1-11)	675	7.6	3.04
Turnover growth (1-5)	673	1.8	0.98
Introduction of new services	793	33%	0.47

Table 3.3 covers general information about the firms. The average firm in the sample have around 70 employees. The standard deviation is quite large and indicates that the variation in the firm is substantial. Half of the responding firms seem to be part of a group, and most of the firms, 8 out of 10, have their headquarters located in Norway. The average turnover is 7.6, measured on a scale of 1 to 11. This is considered a low turnover, and indicates an overweight of small firms. Bear in mind that the firms are asked questions about their period in 2004-2006, and the answers indicate a high turnover growth, 1.8 measured on a scale of 1 to 5.

Introduction of new services amounts to 33%, meaning that one out of three firms in the sample has introduced at least one new or significantly improved service innovation in the period that is investigated. This finding is consistent with the empirical results presented by Evangelista (2000). The Italian innovation survey on services shows that almost one third of service firms (31.1%) introduced a technological innovation in the period of 1993-95. He also finds a positive relationship between the share of innovating firms in services and their size. These results are also supported by Sapprasert (2008), age and size of firms have impacts on the decision to undertake organizational innovation and their economic performance. This relationship between size and innovation will also be investigated in the next chapter by using regression analysis (logit models). In the SIS survey, the firms were asked about service innovation, not technological innovation. However, these empirical results indicate that the service sector is innovative.

Table 3.4: International sales

	Variable	Observations	Mean	St. deviation
	International sales	817	37.6 %	0.48
Delivery mode	Exports	816	19.5%	1.06
	Temporary presence	811	16.5%	0.92
	Licenses	812	7.8%	0.69
	Subsidiary (FDI)	814	14.0%	0.97
	Joint ventures	813	8.1%	0.69
	Foreign clients	815	12.0%	0.86
Type of client	Production	813	23.1%	1.16
	Distribution	812	21.4%	1.07
	Consumers	812	6.7%	0.70
	Public sector	772	9.6%	0.78

In Table 3.4, almost 40% of the firms in the sample carry out international sales, which is in line with the existing literature on internationalization of services (Aharoni and Nachtum 2000; Miozzo and Miles 2002). Many service firms have international activities and the literature review also indicated that services are increasingly using this type of internationalization. It is a traditional internationalization channel, since this is usually the first step for most services, and the channel that is being increasingly used.

Table 3.4 brings together the different delivery modes that are frequently used and the type of client that would be the receiver of those services. Clearly, exports, temporary presence and the use of subsidiaries (FDI) seem to constitute the main channels of delivery. Licenses and joint ventures seem to be less common. Licensing may be difficult when it comes to services, given their intangibility and co-terminality of production and consumption (Miles 2005). Temporary presence and subsidiaries are ways to ensure the service is attractive for the end consumer. Foreign clients (12%) may visit the home country of the service provider, and consume the service in Norway. When the firms are asked which type of client the service is sold to, they emphasize production and distribution (more than 20%), while consumers and public

sector are less important (about 7% and 10%, respectively).

Laursen (2008) reports some empirical results from a Danish survey investigating internationalization and innovation in both manufacturing and services. Around 50% of service enterprises have export activities, while only 20% in this sample report the same activity. A reason for this may simply be that the Norwegian data collection has a larger share of small- to medium sized enterprises (SMEs) that are less likely to be international, as compared to large MNEs, as was more the case in the Danish study.

Table 3.5: International sales of new services

	Variable	Observations	Mean	St. deviation
Delivery mode	Exports	805	9.7%	0.80
	Temporary presence	805	10.0%	0.77
	Licenses	803	6.6%	0.65
	Subsidiary (FDI)	806	9.3%	0.80
	Joint ventures	803	5.7%	0.60
	Foreign clients	806	7.4%	0.70
Geographical area	Nordic	809	14.5%	0.95
	Western EU	805	11.7%	0.84
	Eastern EU	804	5.6%	0.59
	North Amer	804	6.1%	0.63
	Latin Amer	802	2.9%	0.46
	Asia	804	6.3%	0.66
	Africa	803	3.0%	0.45
	Oceania	803	2.7%	0.43

Table 3.5 investigates if the firms have international sales of their innovations. According to the taxonomy on the globalization of innovations (Archibugi and Iammerino 1999) this would be a traditional internationalization channel for innovations. The overall pattern is similar to Table 3.4. However, the most important delivery mode for new services seem to be the following four: export, temporary presence abroad, permanent presence abroad (subsidiaries/FDI), and foreign clients coming to Norway to purchase the services from the firms.

The geographical pattern seem to be based on geographical and cultural proximity, which is often the case for trade in general and services in particular. The most relevant geographical areas for international sales of new services appear to be the Nordic countries (15%) and the Western EU (12%). This is slightly followed by Eastern EU, North America and Asia (around 6%), while Latin America, Africa and Oceania (including Australia) are even less important (2-3%).

Table 3.6: International Cooperation

	Variable	Observations	Mean	St. deviation
	International Cooperation	728	39.4%	0.49
Type of partner	Group	793	18.3%	1.07
	Suppliers	793	24.7%	1.14
	Customers	793	24.5%	1.15
	Competitors	792	13.6%	0.82
	Consultants	793	10.8%	0.75
	R&D labs	793	4.3%	0.56
	Universities	793	5.5%	0.61
	Public research institute	792	4.3%	0.53
Geographical area	Nordic	788	28.7%	1.21
	Western EU	787	25.6%	1.16
	Eastern EU	786	9.5%	0.74
	North America	785	10.7%	0.82
	Latin America	782	3.2%	0.52
	Asia	785	11.6%	0.86
	Africa	783	3.3%	0.51
	Oceania	784	2.8%	0.47
Cooperation motives	Public funds	788	4.5%	3.80
	Workforce qualification	790	14.0%	3.60
	Access to Know-how	791	21.9%	1.03
	R&D	789	12.5%	0.82
	Production	788	14.9%	0.94
	Sales	786	23.5%	1.13
	Access to distribution network	789	20.0%	1.03
	Proximity to customers	789	21.7%	1.09

Table 3.6 describes another important internationalization channel, namely international cooperation to provide existing services. In the survey, 40 % of the firms report having international cooperation. This clearly indicates an internationalization of services, and this channel is not just preserved for traditional manufacturing, as illustrated in the literature overview. The most important partners in international cooperation constitute suppliers and customers (25%). The survey also identify some collaboration within a group, and competitors and consultants are also relevant partners. R&D labs, universities and public research institutes are rare (about 5%). This pattern suggests that services are not so dependent on formal collaboration with R&D labs, universities and public research institutes. Services are more often delivered in relation to the customers need and flexibility, and are often consumed and produced at the same place. Innovation in services are usually developed on an incremental basis, involving close customer feedback.

As in the previous table, the partners are geographically located in the Nordic countries (30%) and Western EU (25%) and Asia, Eastern EU and North America (about 10%). The cooperation motives seem to be access to know-how, direct sales, access to distribution networks and proximity to the customers. Public funds seem to be the least important reason for international cooperation. The importance of proximity to customers (22%) seem to match the characteristics of services.

Table 3.7: International cooperation in innovative projects

	Variable	Observations	Mean	St. deviation
	International innovation cooperation	506	23.1%	0.42
Type of partner	Group	791	8.2%	0.76
	Suppliers	791	9.5%	0.76
	Customers	791	9.5%	0.77
	Competitors	790	3.4%	0.48
	Consultants	789	4.2%	0.50
	R&D labs	790	3.4%	0.47
	Universities	790	3.8%	0.51
	Public research	789	2.5%	0.43
Geographical area	Nordic	789	12.0%	0.87
	Western EU	788	10.8%	0.83
	Eastern EU	787	3.3%	0.46
	North America	788	5.3%	0.57
	Latin America	785	1.2%	0.29
	Asia	787	4.5%	0.60
	Africa	786	1.2%	0.31
	Oceania	786	1.3%	0.33

Table 3.7 indicates the level of international cooperation in innovative projects. This channel is interesting, since it refers to the category of “global techno-scientific collaborations”, as introduced by (Archibugi and Iammerion 1999). 23% of the firms in the sample carry out international cooperation in innovative projects. This share is lower than those reporting to have international cooperation in Table 3.6. The majority of partners are located within the group (8%), as well as with suppliers and customers (almost 10%). This pattern and the geographical areas are identical to the one described in the previous table, and will not be repeated here.

Table 3.8: R&D internationalization

	Variable	Observations	Mean	St. deviation
	R&D outsourcing	717	6.4%	0.25
R&D outsourcing motives	Proximity to customers	785	2.5%	0.44
	Proximity to suppliers	786	2.7%	0.43
	Proximity to universities	785	3.1%	0.42
	Proximity to clusters	785	2.7%	0.45
	Unfavourable legislation in Norway	785	0.6%	0.22
	Favourable legislation abroad	785	0.9%	0.25
	Low labour costs	785	2.0%	0.41
	Access to highly qualified workers	785	3.6%	0.51
Geographical area	Nordic	786	2.9%	0.46
	Western EU	785	2.4%	0.44
	Eastern EU	784	1.5%	0.34
	North America	785	2.2%	0.40
	Latin America	784	0.4%	0.22
	Asia	785	2.1%	0.40
	Africa	784	0.1%	0.14
	Oceania	784	0.6%	0.24

Table 3.8 reports the R&D internationalization of the firms. It appears that 6.4% have this international activity present. Clearly, this is a much less important phenomena than the other two internationalization channels. The is in line with the relevant literature that also mention the complexity and difficulties of locating R&D abroad (Boutillier et al. 2008). This channel is expected to increase in importance the coming years, due to recent developments presented in more detail in Chapter 2. The motives to seek out partners in global R&D seem to be proximity to different actors in the innovation system or national economy: customers and suppliers, access to highly qualified workers, universities and clusters, as illustrated in Table 3.8.

Unfavourable legislation in Norway, or favourable legislation abroad, does not seem to affect the decision to locate the R&D functions abroad. Another issue is access to highly qualified workers (3.6%), as this seems to be a much more crucial factor for keeping R&D HQs in Norway. The current policy situation in Norway often raise the issue of competitiveness of Norway as location for R&D, which is an important challenge. The innovation literature highly value the location of R&D as important for both national and regional innovation systems. However, the Norwegian education system has been criticized by the OECD for lagging far behind our counterparts, especially in math and natural science. The innovation literature also promotes the education in science and technology as crucial for increasing the levels of national and firm level innovation. Those who have moved their R&D facilities, have moved to other Nordic countries (the most important account for 3%), some to Western EU, North America and Asia. Based on the location of geographical area in Table 3.8, it is still plausible to argue that international activities are still mainly focused within the "triad" of North America, Western EU and Asia (Carlsson 2006).

Overall, this third internationalization channel is the least pressing one, and seems to appear after the two first channels have been exploited. This makes sense as well, since outsourcing and managing global R&D is a highly complex issue (Boutellier et al. 2008). Narula and Zanfei (2005:326) report similar patterns of empirical results. Most R&D activities are still located in the host country of the MNE, and continues to be considered a strategic asset. According to them, the internationalization of innovation, measured through R&D abroad in the survey, moves at a slower pace than the two first internationalization channels (international sales and international cooperation). The reason seem to be the difficulties of managing complex technological portfolios, as opposed to only exporting a new product or service. Furthermore, MNEs also need to have a certain internal cohesion. Geography and long distances can reduce the progress of advanced research and development, and become costly and time consuming, as well as drain the internal organizational resources. Vernon (in Narula and Zanfei 2005), referring mainly to US-based multinationals, emphasized the costs of coordinating international innovation activities, in order to maintain relevant information for all parties. Collecting and controlling relevant information across national borders is costly, and must be weighed against the benefits of economies of scale and scope (Besanko et al. 2004).

Carlsson (2006:61) investigates the internationalization of national innovation systems, and notes that "…even if the R&D activities of multinational firms are

increasingly being carried out away from the home centre, the internationalization has not gone very far: R&D is much less internationalized than other corporate activities". It still makes sense for most firms to focus on R&D at the home base, and rather exploit new innovations abroad, through export or FDI, as illustrated by the globalization of innovations (Archibugi and Iammerino 1999). More recently, the desire to acquire technology has been a major motive for multinational firms to locate R&D facilities abroad (Carlsson 2006:61). Technology can be acquired through suppliers, customers, universities, cluster and highly qualified labour (human capital), and all these factors measure about 2-3% in importance for R&D outsourcing.

Another interpretation of these results is that R&D is not so formalised and valued in the service sector. The survey questions may therefore not have captured this phenomena correctly. The heterogenous and intangible nature of internationalization and innovation in services also makes formal R&D more difficult (Evangelista 2000). Finally, it could be noted that these firms may rely more on their previous experience, the qualifications of their personnel, and the exploitation of external knowledge, rather than formal R&D within the firm (Gulbrandsen and Nerdrum 2009).

Table 3.9: Barriers to internationalization

Variable	Observations	Mean	St. deviation
Employment regulation	790	14.7%	0.88
Business activity regulation	789	20.4%	0.95
Infrastructure	789	28.2%	1.07
Language and culture	789	26.5%	1.02
Policy discrimination	788	16.6%	0.87
IPRs protection	789	10.1%	0.76
Network building cost	791	35.5%	1.15
Lack of qualified workers	790	23.8%	0.97
Lack risk capital	789	23.2%	0.99
Geographical distance	790	22.4%	0.98

Table 3.9 reports the last part of the descriptive statistics, and investigates possible barriers to international activities. This is relevant to understand how firms can become more international, or increase their already present activities. There is a clear motivation for this. The literature has identified an “exporter premium” and several positive benefits from exporting (Greenaway and Kneller 2007). Infrastructure (28%), language and culture (26%) as well as network building costs (35%) are the three single most important barriers for the firms in the sample. Services need to have these factors present in order to internationalize. These barriers could also be seen as sunk costs, and if the possible risks and price of failure gets to high, many firms might not be able to carry the costs and would have to exit the market. The barriers can reduce the incentives to internationalize.

The least important barrier seems to be protection of Intellectual Property Rights (10%). Services are often intangible and heterogeneous, and therefore harder to define (Gallouj and Savona 2009). Some companies may also find it useless to apply for patents or trademarks, since it is a costly and lengthy process. The sample consist of many small firms, as illustrated by Table 3.3 presenting general information about the firms. Small firms might just not be able to carry these sorts of additional costs. Also, many service innovations are continuous and developed in close cooperation with customers and suppliers.

These findings are also stimulating when investigating the differences between

sectoral groups. Different barriers seem to be important for different groups. For instance, the group of advanced knowledge providers could face different barriers and challenges than the others. This will be investigated in the ANOVA analysis.

3.6 Conclusions and summary of the main findings from the descriptive statistics

The descriptive statistics have shown the fact that the Norwegian service sector appear to be both innovative and international in scope. 33% of the firms report having introduced a new service innovation, and about 40% benefits from international sales and international cooperation. R&D is not so well exploited, since only 6% have this international activity present. The regional location of these activities carries a consistent pattern based on geographical and cultural proximity. The Nordic countries, as well as the rest of Western EU, North America and Asia are the most preferred locations for internationalization.

The relevance of international sales and international cooperation confirms the increasing scope for tradability and internationalization of services, which has been contested in the literature (Aharoni 2000). Physical proximity and co-location of service providers and customers is still an important aspect of service commercialization, also known as co-terminality (Miles 2005).

The barriers to internationalization can be seen as sunk costs. Infrastructure (28%), language and culture (26%) as well as network building costs (35%) are the three most important barriers for the firms in the sample. Services need to have these factors present in order to internationalize. The least important barrier seems to be protection of Intellectual Property Rights (10%), perhaps due to the heterogeneity and intangibility of services.

4 Statistical Analysis

This chapter carries out further analysis of the Service Internationalization Survey (SIS) collected at the Norwegian Institute of International Affairs (NUPI). This part contributes with an analysis of variance (ANOVA). The intention is to compare the mean of each sectoral group in the proposed taxonomy (Castellacci (2008) to the sample average. A number of variables are selected, based on those that appeared to be more relevant in the previous chapter. The idea here is to further test the research questions empirically, as outlined in Chapter 1. The first research question was mainly answered in the previous chapter: What characterizes innovation and internationalization in Norwegian service firms? In this chapter the focus will be on investigating how the different barriers affect this link, and how this relationship differ among the service industries. The chapter concludes with regression analysis (logit model) with four dependent variables: export, FDI, international cooperation and international R&D (Table 4.2 – 4.5).

The following barriers to internationalization seemed to be the most important to the firms in the survey: infrastructure (28,2%), language and culture (26,5%), network building cost (35,5%) and lack of qualified workers (23,8%). An interpretation of why these appear more relevant, is discussed at the end of Chapter 3. A logical way to further investigate these results, is then to include them in an ANOVA testing. It is then possible to see if there are any sectoral differences among the groups, as stated in the research questions. Clearly, based on the characteristics of the different group in the taxonomy (Castellacci 2008), differences are expected.

4.1 Analysis of Variance (ANOVA)

Table 4.1.: Sectoral differences in internationalization and innovation: Results of ANOVA tests for each sectoral group

	Variable	AKP	PGS	NIS	PIS
General information	Employment	79.9	68.9	98.7	48.8
		(1,04)	(0.00)	(1,25)*	(1,84)**
	Part of a group	0.48	0.49	0.6	0.55
		(1.65)**	(0.87)	(1.46)**	(1.5)**
	Introduction of new services	0.34	0.3	0.49	0.3
		(0.44)	(1.03)	(3.2)	(1.57)**
International sales	International Sales	0.38	0.35	0.27	0.42
		(0.07)	(0.72)	(2.1)**	(1.84)
	Mode: Exports	3.38	3.42	3.64	3.36
		(0.44)	(0.19)	(2.06)**	(1.00)
	Mode: Temporary Presence	3.5	3.5	3.74	3.48
		(0.29)	(0.1)	(2.11)**	(0.91)
	Mode: Subsidiary	3.59	3.59	3.63	3.56
		(0.18)	(0.00)	(0.42)	(0.45)
	Mode: Foreign Clients	3.61	3,57	3.85	3.55
		(0.08)	(0.58)	(2.63)***	(1.22)*
	Client: Production	3.33	3.34	3.53	3.23
		(0.23)	(0.29)	(1.69)	(1.53)*
	Client: Distribution	3.35	3.37	3.51	3.36
		(0.53)	(0.03)	(1.2)	(0.24)
International sales of new services	Mode: Exports	3.65	3.67	3.78	3.73
		(1.12)	(0.44)	(0.81)	(0.99)
	Mode: Temporary Presence	3.66	3.72	3.78	3.7
		(1.07)	(0.39)	(1.06)	(0.09)
	Mode: Subsidiary	3.73	3.76	3.7	3.7
		(0.21)	(0.66)	(0.3)	(0.58)
	Mode: Foreign Clients	3.79	3.73	3.83	3.73
		(0.8)	(0.6)	(0.91)	(0.87)

	Variable	AKP	PGS	NIS	PIS
International cooperation	International Cooperation	0.38	0.33	0.38	0.44
		(0.39)	(1.76)**	(0.28)	(2.06)**
	Partner: Group	3.5	3.62	3.37	3.4
		(0.3)	(1.86)**	(0.96)	(1.27)*
	Partner: Suppliers	3.37	3.4	3.14	3.24
		(1.09)	(1.3)*	(1.37)*	(1.36)*
	Partner: Customers	3.33	3.37	3.23	3.28
		(0.24)	(0.67)	(0.59)	(0.45)
	Motive: Access to know-how	3.42	3.56	3.29	3.32
		(0.36)	(2.08)**	(1.06)	(1.45)*
	Motive: Sales	3.39	3.4	3.17	3.31
		(0.86)	(0.74)	(1.38)*	(0,63)
	Motive: Access to distribution network	3.47	3.58	3.33	3.39
		(0.43)	(1.71)**	(1.12)	(1.19)
	Motive: Proximity to customers	3.47	3.52	3.2	3.29
		(1.58)**	(1.62)**	(1.67)**	(1.92)**
R & D internationalization	R & D outsourcing	0.067	0.036	0.041	0.081
		(0.41)	(1.47)*	(0.82)	(1.34)*
	Motive: Proximity to customers	3.93	3.94	3.92	3.87
		(0.93)	(0.94)	(0.19)	(1.86)**
	Motive: Proximity to suppliers	3.92	3.95	3.91	3.91
		(0,00)	(0.88)	(0.29)	(0.55)
	Motive: Proximity to Universities	3.94	3.97	3.99	3.92
		(0.11)	(0.94)	(1.12)	(1.39)*
	Motive: Access to highly qualified workers	3.96	3.97	4.00	3.96
		(0.31)	(0.37)	(1.21)	(0.76)

	Variable	AKP	PGS	NIS	PIS
Barriers to internationalization	Infrastructure	3.16	3.19	3.45	3.09
		(0.15)	(0.25)	(2.42)***	(1.55)*
	Language and Culture	3.09	3.16	3.57	3.2
		(1.96)**	(0.41)	(3.4)***	(0.22)
	Network building cost	2.82	3.12	3.32	3.00
		(3,1)***	(1.57)**	(2.59)***	(0.2)
	Lack of qualified workers	3.14	3.33	3.56	3.24
		(2.45)***	(1.05)	(2.85)***	(0.17)
International innovation cooperation	International Innovation Cooperation	0.25	0.15	0.19	0.27
		(0.59)	(2.01)**	(0.72)	(1.57)*
	Partner: Group	3.74	3.87	3.74	3.71
		(0.48)	(2.29)**	(0.22)	(1.31)*
	Partner: Supplier	3.74	3.87	3.52	3.69
		(0.26)	(2.58)***	(2.45)***	(0.9)
	Partner: Customers	3.68	3.85	3.69	3.73
		(1.44)*	(2.15)***	(0.44)	(0.07)

All regressions include a constant and dummies for the four sectoral groups

*Significance levels: ***1%, **5%, *10%*

4.1.1 Advanced Knowledge Providers (AKP)

The first column presents the results of the advanced knowledge providers (AKP), also known as knowledge intensive business services (KIBS). To get a better understanding of this specific sectoral group, it is useful to compare it to the other sectoral groups. This is also done in the taxonomic exercise previously in the thesis, see Chapter 2 on theoretical framework for a more detailed description of the different groups. At a closer look, this group has about average employment and seem to be less often part of a group. 34% have introduced a new service in the period of time, in the year 2004-2006. This is in line with the relevant literature, that suggest it is in the very nature of this group to frequently introduce and develop new service innovations (Castellacci 2008).

This group carries out more international sales than the other groups, especially compared to the network infrastructure services (NIS). Almost 7% have R&D outsourcing, almost twice as much as the group of personal services (PGS) and network infrastructure services (NIS), but rivalled by the group of physical infrastructure services (PIS), which has 8%. None of the motives for R&D internationalization stand out as being more important for the advanced knowledge providers (AKP). In the ANOVA testing, all the four sectoral groups seem to perform the same (measured on a 1-4 scale).

A more interesting pattern emerges when investigating the indicators of the barriers to internationalization. Clearly, barriers such as infrastructure, language and culture, network building cost, and lack of qualified workers seem to affect this group more, while the other sectoral groups score much lower on all indicators. The advanced knowledge providers have a lower score, indicated by the higher importance (“1” being a very important barrier for internationalization, and “4” being not relevant). Furthermore, several of these findings are also statistically significant, even at 1% significance levels. This group probably finds it more attractive to compete in international markets, and therefore pay more attention to the barriers. In other words, this group is more affected by the barriers to entry, since they already have more international presence, measured on all the internationalization channels. Their opposite is the network infrastructure services (NIS), as described in the next section. This group seems to perform substantially lower on the indicators.

The fact that this group is more affected by these specific barriers, fits the descriptions in the literature quite well. The very nature of being knowledge intensive demands a sophisticated infrastructure, such as information and communications technology, transport and access to governmental services. The end-product of such services is often intangible and rich in rhetoric and symbolism (Alvesson 2004) and it's value is easily reduced by having presence in a different language and culture. The costs of building networks are important in order to sell their competence to foreign companies, e.g. international sales of new services. Also, if a country or region abroad is able to provide an advanced communication infrastructure, it would promote further technological and economic specialization (Antonelli in Castellacci 2008: 981), which is a fertile ground for the entrance and growth of advanced knowledge providers.

The last question concerns international innovation cooperation, where 25% of the advanced knowledge providers have this activity present, which is quite more than the other groups (15% and 19%). Overall, the group is quite international in scope and the firms included make, on average, an active use of all the internationalization channels considered in the survey. In fact, the ever increasing demand for technological specialization and complex solutions support the growing of advanced knowledge providers, or KIBS (Toivonen 2004). The growth of this group is also closely related to the emergence of the new ICT paradigm (Castellacci 2008). The advanced knowledge providers represent the supporting knowledge base in the economy, and innovation activities in other sectors are all built on this base. Naturally, to keep this position, or justify such a logic, the group of advanced knowledge providers find it necessary to expand internationally and facilitate the diffusion of innovations. The empirical material provided in the ANOVA analysis supports such a logic: they score high on introducing new services and perform international activities, more than the other three groups.

4.1.2 Personal Services (PGS)

The second column describes the group of personal services (PGS). Pavitt (1984) originally described this group (and all other services) as not very innovative. They are supplier-dominated and provide final services for customers in the economic system. Castellacci (2008) also proposes that this group receive most of their input from other service groups, for instance physical and network infrastructure services. They seem to have lower than average employment, and are less part of a group (49%), when compared to the three other sectors. Personal services are more reluctant to introduce new services and 35% of the firms report to have international sales, which is about average, and they perform substantially lower on international cooperation than all the other three groups (33%).

Many of these are small and local firms, such as sale and maintenance of motor vehicles, retail trade, hotels and restaurants. It is most natural to be focused on local customers and not have any ambitions to internationalise. This is reflected in the motives to have international cooperation: access to know-how and distribution networks, sales and proximity to customers are factors of almost no relevance, and they also score highest in the survey ("4" being not relevant in the survey). As a natural consequence of this, personal services (PGS) score highest on being partner with a group, suppliers and customers (3,62), while all the other sectors are more likely to have this type of international cooperation. They also have less incentives to participate in international sales, set up distribution networks or seek proximity to customers. These findings are also significant, and a clear finding that the other groups in general, and the advanced knowledge providers (AKP) especially, have more international cooperation, including foreign partners and motives. Personal services (PGS) also score lowest on the third internationalization channel, R&D outsourcing (3,6%). Probably because producing personal services do not demand much R&D intensity, and they also indicate no motive to seek R&D internationalization, and foreign R&D cooperation with customers, suppliers, universities and so on.

The indicators of barriers to internationalization in this group are all equal to the mean of the whole sample. But on international innovation cooperation, yet again, the group of personal services (PGS) score lowest. Only 15% have undertaken this type of internationalization, while the advanced knowledge providers (AKP), one out of four (25%), have undertaken international innovation cooperation. This finding is

confirmed when looking at the importance of group, suppliers and customer: partners are almost non-existing in the sectoral group of personal services (PGS).

Overall, the internationalization patterns of this group is clearly different than the others presented, and is in line with previous findings in the literature (Castellacci 2008). Firms are on average significantly less innovative (introduced a new service) and less interest in and capability to internationalize. With these results, the taxonomy of sectoral patterns of innovation and internationalization is strengthened.

The group of personal services is located on top of the vertical chain and with an overall low technological content (Castellacci 2008: 983). These characteristics are reflected in the ANOVA results. They have low innovation and internationalization. This makes sense since their dominant innovation strategy would be acquisition of machinery, equipment and external knowledge provided by suppliers. As both the theory and empirical part suggest, this group is expected to lack the capability and resources to organize and maintain their own research and development (R&D). In other words, personal services are receivers of advanced knowledge created elsewhere in the economy, and use this to improve the quality and price of the service that is delivered to the final customer.

4.1.3 Network Infrastructure Services (NIS)

The third column describes the sectoral group of network infrastructure services (NIS). They have much higher employment, on average almost 100 people employed and more than any other group. They also seem to be part of a group far more often (60%), and an incredible 50% have introduced an innovation. This matches the existing literature (Evangelista 2000). Size of the firm, in terms of employment and being part of a group, is highly correlated with innovation. This is in line with the research on Norwegian firms in the period of 1999 and 2004 (Sapprasert 2008).

However, the innovation does not seem to affect international sales (27%), which is lowest of all the groups. This may indicate that most of the service innovations are used to increase the organizations efficiency and generate value for local customers and clients, since exports and subsidiaries (FDI) are almost absent. Production and distribution clients are also lowest of all the groups. When considering international sales of new services, the group does not perform any interesting export or sales.

Suppliers (3,14) and customers (3,23) appear as important partners in international cooperation, representing the highest results of all the groups. The main motivation for this type of cooperation seem to be sales and proximity to the customer. R&D internationalization does not seem to reveal any specific pattern, and the network infrastructure services (NIS) perform just about the same as the average of the whole sample.

The barriers to internationalization seem to be of almost no importance and this group has the least challenges with barriers, such as infrastructure, language and culture, network building costs and lack of qualified workers. These results are all on a significance level of 1%. This makes sense, given this group are less international and make rarely use of any internationalization channels that were the intention to measure. The high innovative capability of industries like telecommunications and financial services are reflected in the taxonomic exercise previously carried out in Chapter 2 (Miozzo and Soete 2001; Castellacci 2008). International innovation cooperation are equal to the sample average, with the exemption of suppliers as partner (3.52), which is actually significant and is the group that have most international innovation cooperation with this group.

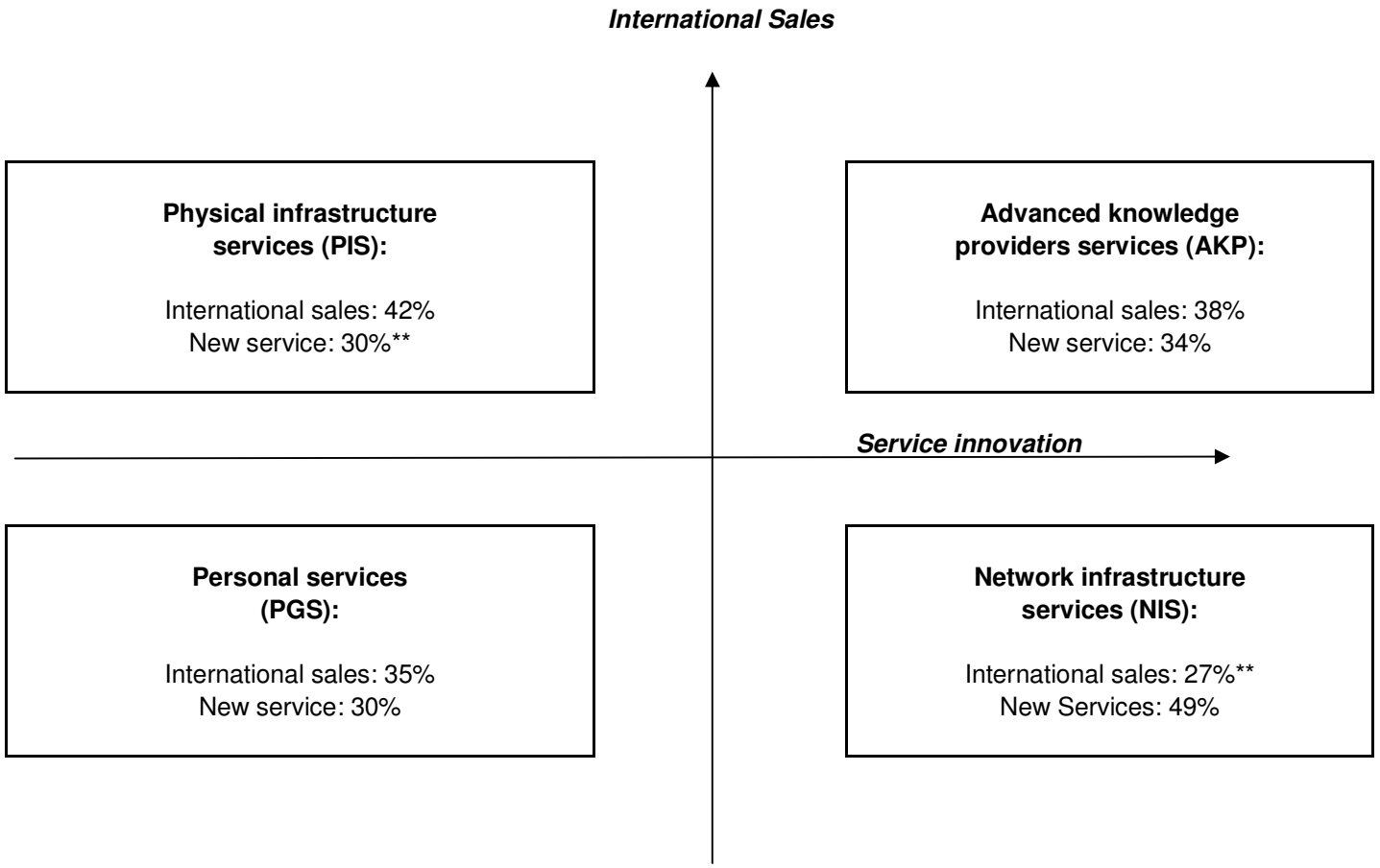
4.1.4 Physical Infrastructure Services (PIS)

The fourth and last column refers to the group of physical infrastructure services (PIS). Firms in this group have on average the lowest number of employees in the sample, about 50 employees per firm. They also have the highest number of international sales (42%), and frequently use exports and subsidiaries (FDI) as modes of internationalization. Important clients seem to be production and distribution. This is not, however, reflected in the international sales of new services, although this group seem to frequently participate in international cooperation (44%), and clearly operates more international than the three other groups. Groups, suppliers and customers seem to be significantly important in international cooperation, and the motivation seem to be access to know-how and proximity to customers.

R&D internationalization is highly important for firms in this group (8%), twice as much as the personal services (PGS) (3,6%) and network infrastructure services (NIS) (4,1%), only challenged by the advanced knowledge providers (AKP) (6,7%). Proximity to customers and universities are significant and relevant motivations. The major barriers to internationalization are infrastructure, network building costs and lack of qualified workers. Especially infrastructure (3,09) is the most important barrier for this group, more than the sample average, and all the other groups. The importance of infrastructure, such as communication, transport or distribution channels, may be explained in terms of the function these sectors have in the economic system as providers of physical infrastructure services. This function requires close ties to the infrastructure facilities available in foreign markets, where Norwegian firms target their international activities (Castellacci 2010).

Despite their low innovation ability (30%), they have a remarkable international performance on all the three internationalization channels considered by the survey, as predicted by the taxonomy.

Figure 4.1: Sectoral patterns of innovation and internationalization in services: Share of firms with international sales and service innovation for each sectoral group



Source: Model adopted from Castellacci (2010)

Statistics are from the ANOVA exercise in Table 4.1

All regressions include a constant and dummies for the four sectoral groups

*Significance levels: ***1%, **5%, *10%*

4.1.5 Conclusion and summary of the main findings form the analysis of variance (ANOVA)

Based on results from the ANOVA statistics, there seems to be a great variety of internationalization patterns across different service industries in Norway. Figure 4.1 (adapted and refined from Castellacci 2010) provides an overview of the main findings. The figure illustrates the relative position of the various sectoral groups along two main dimensions. Their innovative ability is located along the X-axis, and their international performance is located along the Y-axis. The most interesting patterns emerge between international sales and service innovation.

The advanced knowledge providers (AKP) are placed in the upper right corner, and therefore score quite high on both these indicators. Network infrastructure services (NIS) are located on the bottom right corner and just below the advanced knowledge providers (AKP). They perform impressively high on introducing service innovations (almost 50%), but much lower on actual international sales (27%). This seems paradoxical, since they break the main consensus in the literature about the close link between innovative ability and international performance. Physical infrastructure services (PIS) are located in the upper left corner. They have a high score on international sales, but not so high on introducing new services. Finally, personal services (PGS) are located on the bottom left corner, implying low international sales and few service innovations. This last group has a low propensity to internationalize, since they mostly provide services for the final consumers in the end market.

Network and physical infrastructure services score quite differently on innovation and internationalization. This can be explained by this group's relation to the ICT paradigm (Castellacci 2008). One implication of this would be different "opportunity levels" for the two groups, which is reflected in the empirical material from the SIS survey. The level of technological sophistication in the two sub-groups are not the same (Miozzo and Soete 2001), since each corresponds to different paradigms. The physical infrastructure services were more suited for the Fordist paradigm, while the network infrastructure services, such as telecommunications and finance, are the supporting infrastructure of the ICT paradigm (Castellacci 2010).

Overall, the four sectoral groups investigated in the thesis can be split into two categories, based on their function in the economic system. The first category is the providers of advanced knowledge, consisting of advanced knowledge providers and

network infrastructure services. The second category is the receivers of advanced knowledge, products and infrastructure mainly created by the first category. This second category are personal services and physical infrastructure services. The two categories also illustrates the heterogeneity of services, as is often referred to in the literature (Gallouj and Savona 2009). The relative differences between the four sectoral groups, in terms of innovation, is also tested empirically in Castellacci (2008), where ANOVA tests based on the Community Innovation Survey 4 (CIS4) indicated a similar difference between the groups. The empirical results clearly supported the classification into the different sectoral groups.

Laursen (2008), using the same refined taxonomy as Castellacci (2008), finds that the sectoral group of physical infrastructure services has the highest export intensity (65%). This is in line with what is reported in Figure 4.1, where this group clearly more international sales than all the other three groups (about 42%). This clearly matches with Figure 4.1, and supports the argument of sectoral patterns of innovation and internationalization in services.

Sectoral patterns of innovation and internationalization:

Summary of ANOVA results

- **Advanced knowledge providers:** high innovativeness, sales abroad (trade and FDI), and R&D outsourcing
- **Personal services:** low innovativeness, low propensity to internationalize (delivery mode: mobility of foreign clients)
- **Network infrastructure:** high innovativeness, but low internationalization performance
- **Physical infrastructure:** low innovativeness, but remarkable international performance

4.2 Regression Analysis (logit models)

The literature review in Chapter 2 identified a gap in the literature on empirical evidence on these phenomena in general, and even more so for services. There also seem to be less knowledge about the factors explaining the other two channels of internationalization that have been considered in this survey, which is international cooperation and R&D outsourcing (Narula and Zanfei 2005). The data collection and the presented empirical material in Chapter 3 helped to improve this current gap in the research on firm level internationalization. Finally, the survey also collected a novel set of barriers to internationalization (or simply sunk cost). The collected data allows an investigation of all these explanatory factors in the same model. Based on the explanatory variables, it is reasonable to expect different impact and outcome on the dependent variables. For instance, as identified in the ANOVA analysis, sectoral differences are in place, and a regression model allows investigation of the complex relationship between these variables. The purpose is to investigate how the different variables affect the internationalization channels (the dependent variables).

The general purpose, is to provide a more accurate model of the explanatory factors of internationalization in the service sector, and to see how the different barriers and sectoral dummies affect the outcome. The idea is to see how the four dependent variables (internationalization channels) are affected by the other explanatory variables. This is interesting, since this topic is clearly under investigated, as pointed out in the literature review. What is the relationship between the dependent variables and the explanatory variables? The regression models will describe the strength and relation between the variables. It is also an idea to further investigate which of these control variables that have an impact or not. In the descriptive statistics, it was clear that the barriers were significant for the internationalization decision of firms. However, it was not obvious which variables affected which internationalization channels. Are there different barriers for different internationalization channels? To develop a clear and more complete picture of these internationalization channels, several explanatory variables are taken into account. At this point the possible determinants of these different internationalization patterns will be considered. The reviewed literature indicated several relationship between factors that deserve attention. This theoretical and empirical basis will help to prepare a relevant regression model, and investigate the different internationalization channels.

4.2.1 Explanatory factors in the regression model

Firm specific information: The size of the firm (employment), if it is part of a group or not and the labour productivity is usually correlated with economies of scale and scope. According to the main literature visited in Chapter 2, these firm specific variables are positively related to the international performance of enterprises. The reviewed literature on firm heterogeneity identified several firm specific factors that help explain the internationalization presence of firms. The different internationalization channels in the service industries are still rather under investigated. It is therefore highly plausible to control for firm specific information, since this is already identified in the mainstream literature.

Innovation: A more novel explanatory variable includes service innovation. This has been properly addressed in manufacturing, but only to a small extent in services (Beise-Zee and Rammer 2006; Laursen 2008). The innovation variable is measured through question 9 in the survey and indicates if a new or significantly improved service were introduced in the period 2004-2006. Given previous results in the literature on the importance of innovation for international export, this variable is expected to have a positive correlation with the international performance of enterprises.

Other internationalization channels: International sales (export and FDI), international cooperation and R&D abroad (outsourcing) are included in the regression model in order to control for the complementarities between different internationalization channels.

Barriers to internationalization: During the investigation of the survey results in Chapter 3, the following variables appeared to be important and affect the international presence of firms: lack of infrastructure; policy discrimination for the national enterprises; network building cost; lack of qualified workers; geographical distance. The expectation is that the firms that consider these barriers as very relevant, are also more engaged in international activities. Therefore, it is naturally to expect a positive correlation between the relevance of these factors and the internationalization outcome (dependent variable). However, notice that this expectation implies a negative coefficient in the estimates and regression models, since the barriers are measured on a scale from 1-4, where 1 indicates “very important”, and 4 indicates “not relevant at all”.

Sectoral Dummies: these dummies are added to take into the account of other fixed effects not considered by the model, and related to the specific characteristics of the four sectoral groups that have previously been used in the thesis (see Miozzo and Soete 2001; Castellacci 2008): advanced knowledge providers (AKP), personal services (PGS), network infrastructure services (NIS) and physical infrastructure services (PIS).

In some of the models, where it is useful, the international innovation cooperation variable is included as well. This strengthens some of the models and more of the variables become significant and relevant to explain the dependent variable. At times, the variable seems to correlate too much with the dependent variable, and therefore draw the attention from the other ones.

Table 4.2 Regression Analysis (logit model) with the dependent variable export

	(1)	(2)
Dependent variable	**Export**	**Export**
Employment	0.052 (0.43)	-0.054 (-0.40)
Part of a group	-0.019 (-0.08)	-0.107 (-0.36)
Labour productivity	0.457 (2.80)***	0.344 (1.71)*
Introduction of new services	0.930 (3.93)***	0.562 (1.94)**
FDI (subsidiary)		0.679 (1.97)**
International cooperation		1.142 (3.07)***
International innovation coop.		0.619 (1.92)**
R&D internationalization	0.784 (2.10)**	-0.118 (-0.27)
Barrier: Lack of infrastructure	-0.240 (-1.99)**	0.126 (0.84)
Barrier: Policy discrimination	-0.304 (-2.03)**	-0.261 (-1.48)
Barrier: Network building cost	-0.157 (-1.12)	-0.262 (-1.56)*
Barrier: Lack of qualified workers	-0.277 (-1.92)**	-0.077 (-0.42)
Barrier: Geographical distance	0.075 (0.52)	-0.234 (-1.33)
Pseudo R2	0.190	0.248
Observations	641	429

All regressions include a constant and dummies for the four sectoral groups

*Significance levels: ***1%, **5%, *10%*

Table 4.3 Regression Analysis (logit model) with the dependent variable FDI

	(1)	(2)	(3)
Dependent variable	**FDI**	**FDI**	**FDI**
Employment	0.455 (3.12)***	0.303 (1.86)***	0.348 (2.06)
Part of a group	-0.107 (-0.34)	0.035 (0.09)	0.004 (0.01)
Labour productivity	0.906 (3.98)***	0.635 (2.24)**	0.657 (2.23)**
Introduction of new services	0.935 (3.14)***	0.763 (1.99)**	0.813 (2.07)**
Export		0.894 (2.51)***	0.888 (2.43)***
International cooperation		3.037 (3.91)***	3.010 ((3.85)***
International innovation coop.		-0.400 (-0.98)	-0.339 (-0.81)
R&D internationalization	1.382 (3.43)***	0.835 (1.74)*	0.840 (1.70)*
Barrier: Lack of infrastructure	-0.221 (-1.47)	-0.149 (-0.82)	-0.129 (-0.69)
Barrier: Policy discrimination	-0.474 (2.65)***	-0.481 (-2.30)**	0.175 (0.47)
Slope dummy for AKP			-0.941 (-1.93)**
Slope dummy for PIS			-0.774 (-1.68)*
Barrier: Network building cost	-0.051 (-0.28)	0.212 (0.90)	0.203 (0.85)
Barrier: Lack of qualified workers	-0.812 (-4.62)***	-0.806 (-3.55)***	-0.776 (-2.65)***
Slope dummy for AKP			0.200 (0.46)
Slope dummy for NIS			-1.203 (-1.43)

Barrier: **Geographical distance**	0.239 (1.28)	0.052 (0.23)	-0.026 (-0.11)
Pseudo R2	0.346	0.424	0.439
Observations	641	429	429

All regressions include a constant and dummies for the four sectoral groups

*Significance levels: ***1%, **5%, *10%*

Table 4.4 Regression Analysis (logit model) with the dependent variable International Cooperation

	(1)	(2)	(3)
Dependent variable	**Internat. Coop.**	**Internat Coop.**	**Internat Coop.**
Employment	0.196 (1.81)	0.124 (1.07)	0.146 (1.24)
Part of a group	0.695 (3.45)***	0.758 (3.57)***	0.739 (3.45)***
Labour productivity	0.560 (4.29)***	0.429 (3.26)***	0.422 (3.25)***
Introduction of new services	0.935 (4.58)***	0.747 (3.45)***	0.774 (3.55)***
Export		1.056 (3.92)***	1.045 (3.85)***
FDI (subsidiary)		1.436 (4.00)***	1.411 (3.90)***
R&D internationalization	1.648 (3.36)***	1.317 (2.54)***	1.392 (2.70)***
Barrier: Lack of infrastructure	-0.512 (-4.50)***	-0.480 (-4.00)***	-0.649 (-4.47)***
Slope dummy for AKP			0.464 (2.34)***
Barrier: Policy discrimination	-0.052 (-0.35)	0.068 (0.43)	0.060 (0.37)
Barrier: Network building cost	-0.327 (-2.69)***	-0.332 (-2.59)***	-0.288 (-2.18)**
Slope dummy for NIS			-0.537 (-1.47)
Barrier: Lack of qualified workers	0.076 (0.56)	0.262 (1.68)*	0.269 (1.71)*
Barrier: Geographical distance	0.275 (2.07)**	0.245 (1.76)*	0.243 (1.72)*
Pseudo R2	0.219	0.265	0.275
Observations	641	635	635

All regressions include a constant and dummies for the four sectoral groups
*Significance levels: ***1%, **5%, *10%*

Table 4.5 Regression Analysis (logit model) with the dependent variable R&D abroad

	(1)	(2)	(3)
Dependent variable	**R&D abroad**	**R&D abroad**	**R&D abroad**
Employment	-0.032 (-0.19)	-0.164 (-0.90)	-0.248 (-1.26)
Part of a group	0.319 (0.83)	0.354 (0.84)	0.363 (0.84)
Labour productivity	0.468 (1.81)*	0.164 (0.67)	0.207 (0.84)
Introduction of new services	1.500 (3.91)***	1.138 (2.72)***	1.009 (2.36)***
Export		0.374 (0.93)	0.256 (0.62)
FDI (subsidiary)		0.925 (2.13)**	1.021 (2.27)**
International cooperation		1.436 (2.78)***	1.585 (3.01)***
Barrier: Lack of infrastructure	-0.102 (-0.56)	0.026 (0.13)	0.063 (0.32)
Barrier: Policy discrimination	-0.072 (-0.34)	0.083 (0.36)	-0.030 (-0.12)
Barrier: Network building cost	-0.015 (-0.07)	0.096 (0.40)	0.015 (0.06)
Barrier: Lack of qualified workers	-0.699 (-3.32)***	-0514 (-2.21)**	0.020 (0.07)
Slope dummy for AKP			-1.445 (-3.06)***
Barrier: Geographical distance	-0.099 (-0.48)	-0.281 (-1.22)	-0.278 (-1.16)
Pseudo R2	0.223	0.294	0.331
Observations	645	635	635

All regressions include a constant and dummies for the four sectoral groups

*Significance levels: ***1%, **5%, *10%*

Most of the models seem to have a high explanatory power, as indicated by the high pseudo R2. The models also seem to be quite robust, since they include the four sectoral taxonomies as control variables. The significance levels for many exploratory variables in the regressions for the dependent variable R&D internationalization have in general lower than the other regression models. This indicates better data on the other internationalization channels in Table 4.5. The observations vary in range since running different regressions exclude different observations, due to mulicolinearity or lack of information. Most regressors also turn out to be significant on different levels.

4.2.2 Firm specific variables

Employment measures the size of the firm and turns out significant and positive on almost all the dependent variables, and especially for FDI and cooperation. FDI usually require large organizations to manage and facilitate successful subsidiaries, and having international cooperation and a large organization in the home country is beneficial. Such coordination require expertise, managerial and financial resources, which are more likely to be found in large companies (Narula and Zanfei 2005:334). Large firms usually have more resources to use on international activities, compared to smaller firms.

Being part of a group is positive for most of the regressions, but especially for international cooperation, where it turns out both significant on 1% level and has a high positive indicator. Group ownership clearly affects the decision to undertake international cooperation with foreign enterprise.

Labour productivity is positive and significant on all the dependent variables (export, FDI, cooperation), but has the lowest effect on R&D outsourcing. This is in line with the existing findings in the literature (Greenaway and Kneller 2007). Of course, the usual question is if productive firms self-select into exporting and FDI, or if exporting firms become more productive after having started to export (Bernard and Jensen 1999). The SIS survey does not allow a further investigation of this issue, but supports the general correlation between productivity and exporting. Labour productivity is significant and positively related to export (Table 4.2), and even more when looking at FDI. Clearly, this empirical evidence is in line with the literature, as reviewed in Chapter 2. Mayer and Otaviano (2007:22) clearly states that firms with FDI perform better than exporters, and exporters perform better than non-exporters. Exporting firms also tend to be bigger, more profitable and capital intensive, and even more productive and they pay higher wages. By the same measures, FDI-makers perform better than exporters.

Introducing new services (innovation) affect the different internationalization channels tremendously and turns out highly positive and significant on all the models. This is perhaps the best indicator in the whole table, and the only one to turn out significant and positive on all the models. Evangelista (2000:192) and Sapprasert (2008) also find a positive relationship between the share of innovating firms in services and their size, and this pattern is also quite similar to the manufacturing sector. One reason for this may be that large firms are more likely to report that they have

introduced new innovations due to scale of production. Laursen (2008) compared the internationalization of manufacturing and service firms in the Danish economy. His econometric results confirm that innovative activities increase the chance of having international activities. Firms which have introduced a new or substantially improved service, have a much higher probability of having export and FDI. Being competitive in foreign markets is more likely if the firm is already productive in its home country. Increased competition in foreign markets forces firms to be more efficient and stimulates innovation (Greenaway and Kneller 2007:145). It is therefore natural to expect that introducing a new service innovation, will be correlated with having export or FDI present. Tables 4.2 and 4.3 show this relationship.

4.2.3 Barriers to internationalization

The different variables measuring barriers to internationalization turn out negative, as expected. They clearly affect the firms in how they internationalize. The negative relation means the firms internationalize less when the barriers are present. Given the scale by which these indicators are measured, this negative sign should be read as a positive relationship between the relevance of each obstacle and the internationalization outcome. Also, it is plausible to assume that the firms which are international also are more affected and concerned by these variables. However, the effect of these barriers on the different dependent variables differs considerably. Sectoral dummies are also included to further investigate if the barriers affect the different service industries. Table 4.2 (export) does not include any slope dummies.

Lack of infrastructure has a negative impact on international cooperation (Table 4.4), but does not seem to affect FDI and export too much. According to Narula and Zanfei (2005) R&D activities and international cooperation tend to require a higher quality of the local infrastructure, compared to just exporting and FDI. Lack of sufficient infrastructure would surely also lower the effectiveness of (global) innovation systems (Carlsson 2006). This effect seem to be weaker for the group of advanced knowledge providers (AKP). This group may be more able to overcome this sort of barriers than the other goups.

Policy discrimination negatively affects export and FDI, and turns out as an even stronger barrier for the groups of advanced knowledge providers (AKP) and physical infrastructure services (PIS). The output of physical infrastructure services can be public infrastructure development. If governments give preferential treatments to local or national firms, foreign companies may loose the incentives to internationalize. Policy discrimination may also impose laws that are more strict. Policy liberalization is one factor increasing internationalization of services (Aharoni and Nachtum 2000; Miozzo and Miles 2002). This is clearly present here.

If the costs of building networks are too high, it may reduce the propensity of a firm to internationalize. This seems to be an important barrier to both export and international cooperation (Table 4.2 and 4.4), and even stronger for network infrastructure services (NIS). External networks of local counterparts are expensive and time consuming to develop (Narula and Zanfei 2005). Maintaining and establishing strong linkages with government-funding institutions, suppliers, universities, informal networks and other advanced knowledge providers

are costly. Network infrastructure services (i.e. telecommunications and banks) depend even more on the costs of building networks for exports and international cooperation. The costs of integrating activities in local contexts affect the concentration and dispersion of innovative activities (Narula and Zanfei 2005). This partly explains the limits to growth of global management consulting firms (Miozzo and Grimshaw 2006). Even if the largest firms are more cost effective, local niche consultancies may arise and capture the market from US or London based consultancies. The same logic applies in developing countries, or when encountering less stable regimes. The costs of setting up local networks can surpass the potential profits, and the local market is left for the smaller firms. In addition, the multinational consultancies are also left with the costs of communicating and coordinating between the subsidiaries.

The growing importance of networks in successful innovation are emphasized by Powell and Grodal (2005). 50% in the group of network infrastructure services have introduced an innovation in the year 2004-2006, see Figure 4.1 and the results from the ANOVA testing of sectoral groups (Table 4.1). Out of all the groups who were tested in the regressions, this group were affected most by the barrier measuring network building costs. The slope dummy reported a negative coefficient as the average of the group in Table 4.4. The group is apparently more dependent on setting up successful networks in order to export their services and have international cooperation. Networks are also part of the absorptive capacity of the firm (Levin and Cohental 1990).

Lack of qualified workers negatively affect the use of FDI or subsidiaries (Table 4.3) and R&D outsourcing (Table 4.5). In order to set up and maintain efficient subsidiaries, educated people with the right resources would be needed. When this input factor is not present, it becomes harder to benefit from these internationalization channels, especially for R&D, which is considered highly human capital intensive. Lack of qualified workers has a much stronger negative effect for the advanced knowledge providers (AKP). This makes sense, since this group, more than the three other sectoral groups, employs people who are highly educated professionals (e.g. management consultants), and the output usually is complex knowledge. Their internationalization is also highly dependent on the location of the right people (Miozzo and Grimshaw 2006).

Geographical distance does not turn out to have any significant effect overall, but seems to increase the degree of international cooperation. On the other hand, without geographical distance, there would not be any barriers either. Blanc and Sierra (in Narula and Zanfei 2005:327) point to the tacit nature of knowledge. Physical and geographical proximity may be important to harvest the tacit knowledge embedded in the production and innovation activities. “The marginal cost of transmitting codified knowledge across geographic space does not depend on distance, but the marginal cost of transmitting, accessing and absorbing tacit knowledge increases with distance” (Narula and Zanfei 2005:327).

4.2.4 Conclusion and summary of the main findings from the regression analysis (logit model)

Other internationalization channels are highly correlated with the dependent variable in each of the four models. This makes sense, since the literature has identified a close correlation between having international presence in several activities. If a firm is international, it is usually more likely to have other international activities as well. This may be due to economies of scale and scope, and organizational experience with international business and ways to reduce the barriers to internationalization. Furthermore, labour productivity and innovation activities seem to be present before the decision about going international. The regression models have been useful in supporting the investigation of the main research questions in this thesis: how does the barriers affect the relationship between innovation and internationalization, and how are the internationalization of the four sectoral groups affected by the different barriers? Clearly, different barriers affect innovation and internationalization in the service industry, and the four different groups are affected by the barriers in different ways. The results have contributed with some interesting empirical results that support future research on these topics.

Chapter 4 concluded the empirical analysis by introducing some regression models (logit model). There was a need to further understand the relationship between the different variables, and their effect and outcome on the different internationalization channels. Four dependent variables were set up: export, foreign direct investment (FDI), international cooperation and research and development (R&D) abroad. To explain and understand these internationalization channels, a number of explanatory factors were introduced in order to set up the model. Related to the literature review, firm specific variables were identified: the size of the firm, part of a group and labour productivity. The variable measuring service innovation, and other internationalization channels were also included, as well as sectoral dummies for the four groups. Five barriers to internationalization were added, in order to account for the most relevant and important barriers investigated in Chapter 3.

It turns out that size of the firm is positive for foreign direct investments (FDI) and international cooperation. Part of a group also indicated a positive relationship with international cooperation. Productivity was positive for export, FDI and international cooperation, and innovation were positive for all four dependent variables. Lack of infrastructure affected the degree of cooperation, but turned out weaker for the group

of advanced knowledge providers. Policy discrimination was negative for exports and FDI, but had an even a stronger negative effect for advanced knowledge providers and physical infrastructure services. Network building costs were negative for exports and international cooperation, but had an even stronger negative effect for network infrastructure services. Lack of human capital seemed to impact on FDI and R&D outsourcing, and even stronger for advanced knowledge providers. Surprisingly, geographical distance seemed to have little or no affect on all the four internationalization channels. The other internationalization channels turned out to be highly correlated to the dependent variable in each of the regression models. Overall, these correlation patterns are interesting, but deserve a more in-depth treatment in order to take into account the important issues of endogeneity. The regression results are summarized in section 4.2.4.

Summary of regression results

Firm-level variables:

- **Size**: FDI (+), cooperation (+)
- **Part of a group**: cooperation (+)
- **Productivity**: export (+), FDI (+), cooperation (+)
- **Innovation:** all four dependent variables (+)

Barriers to internationalization:

- **Lack of infrastructure:** cooperation (weaker for AKP)
- **Policy discrimination:** exports and FDI (stronger for AKP and PIS)
- **Network building costs:** exports and cooperation (stronger for NIS)
- **Lack of human capital:** FDI and R&D outsourcing (stronger for AKP)
- **Geographical distance:** no significant effect

Other internationalization channels:

- Most of the regressors measuring ***Other internationalization channels*** turn out to be highly correlated to the dependent variable in each of the four models
- These correlation patterns are interesting, but deserve a more proper treatment to take into account the important issues of endogeneity (e.g. by means of instruments and/or lagged variables)

5 Conclusion and Policy Implications

Chapter one introduced the overall motivation and idea for the thesis, as well as provided three research questions to be investigated:

- What characterizes innovation and internationalization in services?
- How do different barriers affect this link?
- How does this relationship differ among service industries?

The overall structure and outline of the thesis were presented, as well as some expectations.

Chapter two introduced the theoretical framework and reviewed the relevant literature in order to prepare the research methodology. This chapter revealed an increasing understanding of firm level heterogeneity. Due to recent advances in data sets and empirical analysis, the traditional model where all firms export or exit the market, has been challenged. Rich evidence now support that even in the same industry, within the same context, firm level productivity seem to affect the propensity to internationalize (Bernard and Jensen 1999). Exporting firms are more productive and have more international activities. This is often referred to as “exporter premium”. By the same measures, firms with FDI perform better than exporters. This literature, however interesting, seem to have neglected or ignored services, and most of the empirical findings refer to manufacturing plants. There is a gap in the literature in explaining the internationalization of services in general, and firm-level heterogeneity especially. This creates both a research argument and a policy rationale to further investigate these issues.

There also appeared to be a link between export performance and innovation (Laursen 2008). The most successful firms benefit from their innovation activities and export status, while less successful seem to have none of these activities present. Competing in foreign markets forces firms to be more efficient and stimulates innovation (Greenaway and Kneller 2007). Several barriers to internationalization were discussed, such as transportation costs, expenses of setting up distribution channels, geographical distance, different language, historical ties, cultural and geographical proximity. Some of these would be considered sunk costs.

Some of the latest trends in international cooperation and international R&D were

illustrated. It appeared that international joint ventures have received much more attention in the last decades, and these forms of collaboration turned out to be essential for corporate strategy. Many firms now consider these channels as critical, although they appeared to be less developed than export and FDI. It is more complex and time consuming to set up global R&D networks. Those that succeeds are truly MNEs. Many use these types of collaboration to absorb new technology and develop internal capabilities, which is beneficial for the knowledge intensive sectors. International strategic technology partnering can involve universities, consortia, licensing, customers and suppliers, acquisitions, joint ventures and alliances and commercial research organizations (Narula and Zanfei 2005). MNEs are responsible for about half of the global expenditure on R&D, and at least two-thirds of the business spending on R&D (UNCTAD 2005). Firms also spent an average of 28% of their R&D budget abroad in 2003 (Boutillier et al 2008).

One way to analyze the factors influencing the location of R&D, is to map the centralization and de-centralization of technology (Narula and Zanfei 2005). The main advantages of centralization refers to economies of scale and scope in the R&D process, control of linkages and innovation within the local environment. Advantages of de-centralization include the linkages between innovative activities and local production, market, suppliers, and clients and the benefits of technological competence and labour pool. In the end, there are also failures in international R&D. Lhuillery and Pfister (2009) reported results that indicated a 14% failure of R&D cooperation.

This chapter also introduced a practical and well-known taxonomy called “the globalization of innovations” (Archibugi and Michie 1995: Archibugi and Iammerino 1999) to summarize the different internationalization channels discussed above. This taxonomy was used to illustrate the generation, transmission and diffusion of technologies. The first group is the “international exploitation of nationally produced innovations”, and includes export and FDI. The second group referred to “global techno-scientific collaborations”, and includes strategic technology partnering, joint ventures and other forms of collaborations. The third group was the “global generation of innovations” and mainly refers to global R&D networks. This is usually carried out by MNEs. It also appears that this last category is the least developed. This taxonomy provided the main conceptual structure that was used to develop the “Service Internationalization Survey” (SIS). An overview of the taxonomy and the

related survey questions was provided in Table 2.1.

To cater for sectoral differences, a new taxonomy of sectoral patterns of innovation were introduced (Miozzo and Soete 2001; Castellacci 2008). It separated the service sector into four categories: advanced knowledge providers (AKP), network infrastructure services (NIS), physical infrastructure services (PIS) and personal services (PGS). They all have their location in the vertical chain, depending on if they produce services for the final market, or intermediate services used as input for other industries. The first group of advanced knowledge providers is identical to knowledge intensive business services (KIBS), which has received much attention in the literature. The taxonomy was investigated empirically in Chapter 4 and the analysis of variance (ANOVA).

Service innovation and internationalization of services are two interrelated topics of increased interest. The service sector now constitute the majority of employment and output in industrial countries (EMCC 2005). There has also been an unprecedented growth in export and FDI in services. International trade in services accounted for about 30% of exports and 60% of FDI in the OECD area is targeted towards services (Grünfeld and Moxnes 2003). Several reasons have been proposed to explain the rise and growth of the service industry. One is the income elasticity of the consumption of services, while another one is the outsourcing argument (Castellacci et al. 2009). Other reasons may be political liberalization and trade agreements on services, such as EU's internal market, North America Free Trade Agreement (NAFTA) and the General Agreement on Trade and Services (GATS).

The literature on innovation in services pointed out the difficulties of identifying and correctly measuring innovations in services. Innovation studies have usually been occupied with manufacturing. This branch of research has developed recently, but have historically been hampered by old assumptions of services as being innovation laggards or non-innovative (Malerba 2005). There has also been a lack of suitable data sets to do proper analysis. Furthermore, innovation and economic performance seems to be closely linked. Export, competitiveness and productivity are all interrelated with innovation in services, and also motivates a further investigation of these factors. Services are by nature intangible, which makes them harder to transport, store and export. The use ICTs seem to have contributed to an increase in efficiency and tradeability of services (Evangelista 2000). There has been a distinction between three theoretical approaches to innovation in services:

assimilation, demarcation and synthesis. These perspectives have helped to understand the nature of services. There is also a relationship between innovation and economic performance, even though this relationship has been less investigated, due to methodological and conceptual difficulties (Castellacci et al. 2009). Innovation is clearly positively affected by past economic performance and innovation activities have a positive impact on growth and productivity.

Based on the literature review, several gaps in the literature was identified. In order to make a contribution to the research on these topics, three research questions were constructed and motivated.

Chapter three presented the research methodology and the questionnaire that was introduced to capture the nature of service innovation and internationalization of services. The data collection process encountered several challenging e-mails, but these were overcome and addressed properly. In order to create four different groups based on the taxonomy proposed by Castellacci (2008), firms were split based on their NACE classifications, as illustrated in Table 3.1. The data collection process included three phases and collected a total of 814 responding firms with a response rate of 19%, see Table 3.2. The group of network infrastructure services (NIS) had a lower number of invited firms, but an overall higher respondent ratio (32%). There are overall fewer firms in the economy that belong to this group, such as post and telecommunications, financial intermediation, insurance and pension funding. The survey results are representative samples of the Norwegian economy and reflect the relative population of the various groups.

The descriptive statistics of the collected sample showed that the Norwegian service sector is indeed quite innovative. One out of three firms in the sample has introduced an innovation, defined as a new or significantly improved service in the year of 2004-2006. The average firm in the sample have about 70 employees, and based on the reported turnover, there seem to be an overweight of small firms in the sample. Almost 40% of the firms have international sales present and export, temporary presence and the use of subsidiaries (FDI) constitute the main channels of delivery. The receivers seem to be clients within production or distribution. International sales of new services is less present, but follows the same pattern. The geographical area in which services locate their international sales seem to be based on geographical and cultural proximity, which is often the case for trade in general and services especially. The most relevant geographical areas for internationalization of services

in the sample appear to be the Nordic countries, Western EU, North America and Asia. On the other hand, Latin America, Africa and Australia are less important for these activities.

40% of the firms report having international cooperation, and this illustrates the internationalization of services. The most important partners in international cooperation constitute suppliers and customers (25%). The empirical findings in this section also supports that services are not so dependent on formal collaboration with R&D labs, universities and public research institutes (5%). Services are more often delivered in relation to the customers need and flexibility, and are often consumed and produced at the same time. The cooperation motives for having partners abroad seem to be access to know-how, direct sales, access to distribution networks and proximity to customers. Public funds seem to be the least important reason for international cooperation. 23% of the firms report having international cooperation on innovative projects, and this share is obviously lower than just having international sales or cooperation. The majority of partners are located within the group (8%), as well as suppliers and customers (8%).

International R&D accounts for only 6%, and is clearly a much less developed phenomena than the other internationalization channels. This is in line with the literature investigated in Chapter 2, and states the complexity and difficulties of locating R&D abroad. However, this internationalization channel is expected to increase even more in the coming years, due to reasons illustrated in Chapter 2. The motives to seek out partners in global R&D seem to be proximity to different actors in the innovation system, especially customers and suppliers, access to highly qualified workers, universities and clusters, as illustrated in Table 3.8. Another interpretation of these results on R&D abroad, is that formalized R&D is less present, due to the heterogeneity and intangibility of services.

In order to understand how firms can become more international, or increase their already present activities, barriers to internationalization were reported in Table 3.9. Infrastructure (28%), language and culture (26%) as well as network building costs (35%) are the three single most important barriers for the firms in the sample. These barriers could also be seen as sunk costs, and if the possible risks and price of failure gets to high, many firms might not be able to carry the costs and would have to exit the market. The least important barrier seem to be protection of intellectual property rights (10%). Many service innovations are continuous and developed in

close cooperation with customers and suppliers. Applying for patents and trademarks are a costly and lengthy process that may not benefit the firm.

The empirical findings in Chapter 3 could have some policy implications. At least, there seems to be no reason to discredit the overall service sector and give preferential treatment to manufacturing. The service sector is fully capable of introducing innovations, and having an international presence. The capability to innovate and the ambitions to seek markets abroad could be further facilitated or supported by research and technology policy, as well as innovation policy. The barriers that were pointed out, namely infrastructure, language and culture and network building costs, could be further investigated in the service sector. Policy could help to reduce or overcome these barriers in an early phase and promote the internationalization of Norwegian services, as well as attract service firms from abroad, especially those that would be knowledge intensive business services, since they provide advanced knowledge to other service and manufacturing industries (Castellacci 2008). Some groups, such as personal services, are simply not very innovative, and lack the ambitions needed to expand their activities in a national and international context.

Policy-making institutions could beneficially redirect and refine some policies regarding these sectoral groups. Supporting and developing the group of advanced knowledge providers is of critical importance for the economy, both in terms of employment, turnover, innovation, knowledge spill-over and internationalization (see Toivonen 2004, Nahlinder 2005, EMCC 2005; Miozzo and Grimshaw 2006).

Chapter 4 continued to investigate innovation and internationalization of services, but sought to reveal potential sectoral patterns, as indicated by the taxonomy introduced in Chapter 2 (Castellacci 2008). The mean of each sectoral group was compared to the sample average, in order to facilitate an analysis of variance (ANOVA). There turned out to be significant differences between the four groups. The group of advanced knowledge providers had high innovativeness, sales abroad (trade and FDI), and R&D outsourcing. Personal services had low innovativeness and foreign clients coming to Norway to purchase the service. Network infrastructure services had high innovativeness, but remarkably low internationalization performance. Finally, the group of physical infrastructure services had low innovativeness, but remarkable international performance. These main findings were summarized and illustrated in section 4.1.5 and Figure 4.1.

Chapter 4 continued the empirical analysis by introducing some regression models (logit model). There was a need to further understand the relationship between the different variables, and their effect and outcome on the different internationalization channels. Four dependent variables were set up: export, foreign direct investment (FDI), international cooperation and research and development (R&D) abroad. To explain and understand these internationalization channels, a number of explanatory factors were introduced in order to set up the model. Related to the literature review, firm specific variables were identified: the size of the firm, part of a group and labour productivity. The variable measuring service innovation (question 9 in the survey), and other internationalization channels were also included, as well as sectoral dummies for the four groups. Five barriers to internationalization were added, in order to account for the most relevant and important barriers investigated in Chapter 3.

It turns out that the size of the firm is positively correlated with foreign direct investments (FDI) and international cooperation. Being part of a group also indicated a positive relationship with international cooperation. Productivity was positive for export, FDI and international cooperation, and innovation were positive for all four dependent variables. Lack of infrastructure affected the degree of cooperation, but turned out weaker for the group of advanced knowledge providers. Policy discrimination was negative for exports and FDI, and had the greatest negative impact on advanced knowledge providers and physical infrastructure services. Network building costs were negative for exports and international cooperation, and even stronger negative effect for the group of network infrastructure services. Lack of human capital seemed to impact on FDI and R&D outsourcing, especially for advanced knowledge providers. Surprisingly, geographical distance seemed to have little or no effect on all the four internationalization channels. The other internationalization channels turned out to be highly correlated to the dependent variable in each of the regression models. Overall, these correlation patterns are interesting, but deserve a more proper treatment in order to take into account the important issues of endogeneity. These regression results are summarized in section 4.2.4.

The public policy toward innovation in Norway has changed (Gulbrandsen and Nerdrum 2009). In 2009 the Norwegian government released their first report on innovation called “Et nyskapende og bærekraftig Norge” (Stortingsmelding nr. 7/2009). In Chapter 5.3.6. service innovation is highlighted as a potential area for

support and development. My thesis contributes to knowledge in this area, and strengthens the argument for supporting new growth within the service sector in general and the advanced knowledge providers and network infrastructure services in particular.

In order to facilitate further internationalization of Norwegian service firms, as investigated in the SIS survey, barriers to internationalization need to be reduced, either by the home country, or by the foreign country. Chapter 3 points out the most important barriers (infrastructure, language and culture, network building costs and lack of qualified workers), while Chapter 4 address different barriers impact on different internationalization channels, and also finds some sectoral differences related to these barriers.

The service sector deserves more research, especially on the firm-level variables that help explain the relationship with innovation and internationalization. These are crucial links that are still being investigated in the current literature (Castellacci 2010). Also, a more in-depth study of the different barriers and their hampering effects would be justified. There are clear reasons to expect a continued growth of innovation and internationalization of services. These aspects are also controversial, as they are related to trade policies and trade liberalization.

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Appendix A Questionnaire

Question 1
Is the enterprise part of a group?

Yes ☐
No ☐

Question 2
Is the enterprise a parent company or a subsidiary?
Please cross the suitable alternatives.

Parent company ☐
Subsidiary ☐

Question 3
In which country is the headquarters?

Question 4[1]
How many employees, including part-time, did the enterprise have in 2006?
(Pick an alternative: 0-9, 10-19, 20-49, 50-99, 100-249, 250-499, 500 or more)

If your enterprise is a Norwegian parent company with subsidiaries in Norway or abroad, the answers should refer to the group as a whole. If the enterprise is a subsidiary company of a foreign group, the answers should refer only to the Norwegian firm (and subsidiaries of this Norwegian firm). Unless a specific period or year is stated, we would like you to consider your enterprises situation now when answering

[1] This question was added in the web-based questionnaire, but the number of employees was asked for in some cases in the phone based data-collection. The reason for including the question later was that originally the registered number of employees in BoF was to be used, but as these numbers were from 2005, the question was added to have a newer estimate of the enterprises size in terms of employees.

International Sales

By **international sales** we mean the total of the enterprise's sales of services abroad sold by means of one or more of the following channels: exports; licensing agreements or franchise; sales by temporary presence of the enterprise's personnel abroad; sales by the enterprise's affiliates, subsidiaries, or branches in foreign markets. International sales can also be sales where a non-Norwegian customer who is based abroad consumes the service in Norway.

Question 5

Did your enterprise have any international sales in 2006?

Yes ☐

No ☐

If the answer to question 5 is no, go to question 9[2]

Question 6

Please indicate the percentage of your total turnover that came from international sales in 2006.

Below 20%[3] ☐

20%- up to 40% ☐

40%-up to 60% ☐

60%-up to 80% ☐

80%- up to 100% ☐

[2] This comment and subsequent comments that guides the respondent to skip certain questions, was/were expressed explicitly only in the web-based questionnaire, but a selection of questions based on the respondents' answers was made also in the phone-based data-collection.

[3] Phrasing in the Word-based questionnaire for this alternative was "0%- up to 20%"

Question 7[4]

When considering your enterprise's customers **abroad**, how important are the following types of clients? Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Production companies[5]	☐	☐	☐	☐
Trading companies[6]	☐	☐	☐	☐
Private customers(Households etc)[7]	☐	☐	☐	☐
Public sector[8]	☐	☐	☐	☐

[4] In earlier questionnaire this was Question 9 (after the section that is question 8- question 11 here). Questions 8-11 here had the numbers 5-8.

[5] In earlier questionnaires this was two separate alternatives: "Multinational production companies " and "Local production companies"

[6] In earlier questionnaires this was two separate alternatives, "Distribution companies" and "Retail enterprises"

[7] In earlier questionnaires this was phrased as "Consumers, households"

[8] This option was not included earlier version but was added in the web-based questionnaire.

Question 8

How important are the different channels listed below for your enterprise's total international sales. Please cross one box each line

	High importance	Medium importance	Low importance	Not used
Exports	☐	☐	☐	☐
Temporary presence of the enterprise's personnel abroad.	☐	☐	☐	☐
Licensing agreements or franchises[9]	☐	☐	☐	☐
Own company abroad	☐	☐	☐	☐
Joint venture	☐	☐	☐	☐
Foreign customer consumes the services in Norway[10]	☐	☐	☐	☐

A **service innovation** is the market introduction of a **new** service or a **significantly** improved service with respect to its capabilities, such as quality, user friendliness, software or subsystems. The innovation must be new to your enterprise, but it does not need to be new to your market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises.

Question 9

During the period 2004-2006 did your enterprise introduce new or significantly improved services?
Please cross one box.

Yes ☐
No ☐

If the answer to question 9 is no, go to question 12

[9] In earlier questionnaires this was phrased as "Licensing agreements". In the web-based survey (and e-mails sent to hotels & restaurants in the phone survey) "or franchises" was added.

[10] In earlier questionnaires this was phrased as "Foreign customer is present in Norway for sale/production/delivery (e.g. tourists)

Question 10

Consider now these **new services**. How important were the alternatives listed below for the international commercialization of these new services? Please cross one box each line.

	High importance	Medium importance	Low importance	Not used
Exports	☐	☐	☐	☐
Temporary presence of the enterprise's personnel abroad.	☐	☐	☐	☐
Licensing agreements or franchises[11]	☐	☐	☐	☐
Own company abroad	☐	☐	☐	☐
Joint venture	☐	☐	☐	☐
Foreign customers consume the service in Norway[12]	☐	☐	☐	☐

Question 11

Where were these **new services** sold?
Please indicate the importance of each of the regions listed below. Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Nordic countries except Norway	☐	☐	☐	☐
Western European countries except Nordic countries	☐	☐	☐	☐
Eastern European countries	☐	☐	☐	☐
North America (USA and Canada)	☐	☐	☐	☐
Latin America	☐	☐	☐	☐
Asia	☐	☐	☐	☐
Africa	☐	☐	☐	☐
Oceania	☐	☐	☐	☐

[11] See footnote 5

[12] See footnote 6

Barriers to internationalization

Question 12

What are the main barriers to the internationalization of your company? Please indicate the importance of following factors. Please cross only one box for each line

	High importance	Medium importance	Low importance	Not relevant
Regulations concerning presence of personnel (e.g. working permission, licences to operate within a profession, residence permits or visas)	☐	☐	☐	☐
Regulations on foreign business activity (e.g restrictions on sales, marketing, product standards, foreign investments etc)	☐	☐	☐	☐
Infrastructure (Communication, Transport or distribution channels)	☐	☐	☐	☐
Language barriers or cultural barriers	☐	☐	☐	☐
Discrimination vis-à-vis national enterprises	☐	☐	☐	☐
Inadequate protection of intellectual property rights	☐	☐	☐	☐
Costs of building up a contact network abroad	☐	☐	☐	☐
Lack of qualified workers	☐	☐	☐	☐
Lack of risk capital	☐	☐	☐	☐
Difficult to deliver service across distance	☐	☐	☐	☐

International co-operation

By **international co-operation** we mean active participation on one or more activities with other enterprises or non-commercial institutions that are non-Norwegian and that are located abroad. Exclude pure contracting out of work with no active co-operation.

Question 13[13]

Did the enterprises have international co-operation during 2004-2006?

Yes ☐

No ☐

If the answer to question 13 is no, go to question 20

Question 14

For each of the alternatives listed, please indicate the importance of this type of international co-operation partner during the period 2004-2006. Please cross one box each line.

	High importance	Medium importance	Low importance	Not used
Other enterprises within your enterprise group	☐	☐	☐	☐
Suppliers of equipment, materials, services, or software	☐	☐	☐	☐
Clients or customers	☐	☐	☐	☐
Competitors or other enterprises in your industry	☐	☐	☐	☐
Consultants, consultancy enterprises	☐	☐	☐	☐
Commercial labs, or private R&D institutes	☐	☐	☐	☐
Universities or other higher education institutions	☐	☐	☐	☐
Public research institutes	☐	☐	☐	☐

[13] Question not included in earlier questionnaires

Question 15

Where was(were) your international co-operation partner(s) located? Please indicate the importance of each of the listed regions. Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Nordic countries except Norway	☐	☐	☐	☐
Western European countries except Nordic countries	☐	☐	☐	☐
Eastern European countries	☐	☐	☐	☐
North America (USA and Canada)	☐	☐	☐	☐
Latin America	☐	☐	☐	☐
Asia	☐	☐	☐	☐
Africa	☐	☐	☐	☐
Oceania	☐	☐	☐	☐

Question 16

There can be various reasons for engaging in international co-operation. What was the purpose of your enterprise's international co-operation during the period 2004-2006? Please indicate the importance of each of the alternatives listed. Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Public co-financing	☐	☐	☐	☐
Adding to the qualifications of the workforce	☐	☐	☐	☐
Access to know-how	☐	☐	☐	☐
Research and development	☐	☐	☐	☐
Production	☐	☐	☐	☐
Sales[14]	☐	☐	☐	☐
Access to distribution networks	☐	☐	☐	☐
Proximity to customers	☐	☐	☐	☐

Other, please specify:_____

[14] There were two alternatives in the earlier version "*Sales*" and "*International sales*", but these two were put together in the web-based questionnaire.

International innovation co-operation

Innovation co-operation is the active collaboration with other enterprises or non-commercial institutions on R&D and other innovation activities, i.e. on activities that are related to the development of new services, new products or new processes. Exclude pure contracting out of work with no active co-operation.

Question 17[15]

Did the enterprise have innovation co-operation with other international co-operation partners during 2004-2006?

Yes ☐

No ☐

If the answer to question 17 is no, go to question 20

Question 18

How important were each of the listed types of co-operation partners in your enterprise's international innovation co-operation during 2004-2006. Please cross one box each line.

	High importance	Medium importance	Low importance	Not used
Other enterprises within your enterprise group	☐	☐	☐	☐
Suppliers of equipment, materials, services, or software	☐	☐	☐	☐
Clients or customers	☐	☐	☐	☐
Competitors or other enterprises in your industry	☐	☐	☐	☐
Consultants, consultancy enterprises	☐	☐	☐	☐
Commercial labs, or private R&D institutes	☐	☐	☐	☐
Universities or other higher education institutions	☐	☐	☐	☐
Public research institutes	☐	☐	☐	☐

[15] Question not included in earlier questionnaires

Question 19

Where was(were) your international innovation co-operation partner(s) located? Please indicate the importance of each of the listed regions. Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Nordic countries except Norway	☐	☐	☐	☐
Western European countries except Nordic countries	☐	☐	☐	☐
Eastern European countries	☐	☐	☐	☐
North America (USA and Canada)	☐	☐	☐	☐
Latin America	☐	☐	☐	☐
Asia	☐	☐	☐	☐
Africa	☐	☐	☐	☐
Oceania	☐	☐	☐	☐

R&D(research and development) performed by your enterprise abroad

Question 20

Does your enterprise have R&D facilities[16] abroad?

Yes ☐

No ☐

If the answer to question 20 is no, go to question 23

Question 21

Where are your enterprise's R&D facilities located? Please indicate the importance of each of the listed regions. Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Nordic countries except Norway	☐	☐	☐	☐
Western European countries except Nordic countries	☐	☐	☐	☐
Eastern European countries	☐	☐	☐	☐
North America (USA and Canada)	☐	☐	☐	☐
Latin America	☐	☐	☐	☐
Asia	☐	☐	☐	☐
Africa	☐	☐	☐	☐
Oceania	☐	☐	☐	☐

[16] The Norwegian word used was "virksomhet" (≈activities, operations)

Question 22

What was the main reason(s) for the enterprise to locate R&D facilities abroad?
Please indicate the importance of each of the alternatives listed. Please cross one box each line.

	High importance	Medium importance	Low importance	Not relevant
Proximity to customers	☐	☐	☐	☐
Proximity to suppliers	☐	☐	☐	☐
Proximity to universities/ research centres	☐	☐	☐	☐
Proximity to advanced research/industrial clusters	☐	☐	☐	☐
Unfavorable legislation in Norway	☐	☐	☐	☐
Favorable legislation abroad	☐	☐	☐	☐
Low labor costs	☐	☐	☐	☐
Access to highly qualified workers	☐	☐	☐	☐

Other, please specify:_____

Question 23[17]

What was the enterprises total turnover in 2006? Answer in NOK

(Pick an alternative)

- Below 20 million ☐
- 20 million - below 30 million ☐
- 30 million - below 40 million ☐
- 40 million - below 50 million ☐
- 50 million - below 75 million ☐
- 75 million - below 100 million ☐
- 100 million - below 250 million ☐
- 250 million - below 500 million ☐
- 500 million - below 750 million ☐
- 750 million - below 1 billion ☐
- More than 1 billion ☐

[17] In the earlier version of the question was open

Question 24

How has the enterprises total turnover developed the last 5 years?

Strong increase	☐
Slight increase	☐
More or less unchanged	☐
Slight decrease	☐
Strong decrease	☐

Question 25[18]

Which function within the enterprise does the respondent have?

CEO or similar	☐
Economy	☐
Information and communication	☐
International sales/International department or similar	☐
Technology/ Research/Development or similar	☐
Other	☐

[18] In the earlier version of the question was open